

*From the Ear, Nose and Throat Department of the Garrison Hospital, Boden,
and the Norrbotten Province Central Sanatorium, Sandträsk.*

(Principals: Dr. Nils Froste and Dr. Gösta Helleberg.)

BRONCHOSCOPY IN PULMONARY TUBERCULOSIS

A clinical study of 1,001 cases of
bronchoscopic examinations

by

NILS FROSTE

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FOREWORD

As consulting bronchoscopic specialist of the Central Sanatorium in Sandträsk, I have had the opportunity of carrying on a rather far-reaching bronchoscopic activity in cases of pulmonary tuberculosis. The head physician of the sanatorium, Dr Bo Carstensen, who was head physician during the time that the investigation extends over, has taken a lively interest in bronchoscopic activity, and has been the stimulating force from the very beginning. Dr Carstensen's successor, the head physician of the sanatorium, Dr Gösta Helleberg, has shown the same great interest in bronchoscopic activity. Several control bronchoscopic examinations have also been carried out on earlier material during Dr Helleberg's time. During the time that I have been working up the material, Dr Helleberg has also been of very great help to me in questions touching pulmonary tuberculosis. I beg to tender my best thanks to Dr Carstensen for the stimulation he has always provided me with in connection with these bronchoscopic investigations, and for all the help he has given me in this investigation. I am also deeply indebted to Dr Helleberg for all the help he has given me during the realisation of this work, and for his willingness to put all the archives and the library of the Central Sanatorium at my disposal.

I am also deeply indebted to Prof. Torsten Skoog for all the support he has given me during the final period of the investigation, for the great interest that he has shown in my work and for the help he has given me with advice and guidance.

To Docent Alf Westergren I also offer my grateful thanks for the work he has done, and for the time he has spent in examining purely tuberculous facts which must from natural causes be included in a revision of bronchoscopic examinations in pulmonary tuberculosis, and which a bronchoscopic expert is not always able to deal with.

I should also like to express my gratitude to the secretaries of the Central Sanatorium, who have always helped me in my work with the records at the sanatorium with the greatest alacrity.

My best thanks are also due to all the many helpers who have been of such great assistance to me in carrying out these bronchoscopic examinations. I refer more particularly to my various assistants, nurses and the nursing staff.

The translation is the work of Mr. E. F. Holloway to whom I should like to express my gratitude for the work he has done.

Finally, I must thank my wife for all the help she has given me in correcting the manuscripts and reading the proofs, as well as in verifying the tables.

Boden, March 1950.

Nils Froste

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INTRODUCTION

Chevalier Jackson has coined the phrase: There are three ways of examining the lung. We may look at it from the outside by inspection, palpation and auscultation; we may look through it by means of the X-ray; and we may look at it from the inside by means of the bronchoscope (quoted from Lloyd and Budetti). Therein has been indicated the extent of the possibilities of bronchoscopic examination, and the place occupied by bronchoscopy in diseases of the lungs. In connection with this quotation, the authors have set out certain fundamental premises regarding bronchiogenic complications in pulmonary tuberculosis: a) A lesion in the parenchyma of the lung always results in changes in the membrane of the draining bronchus. b) The lesion of the bronchus is of the same character as the lesion in the lung. c) The bronchial lesion is a direct extension into visible airways from the original site of invasion (lung parenchyma or lymph gland). d) Changes in the pulmonary lesion are constantly signaled by changes in the bronchial lesion. e) Bronchoscopy, therefore, affords an avenue for direct study of the character and progress of a tuberculous lesion in the lung.

With these basic principles before his eyes, the author has sought to answer the question as a bronchoscopic expert for the material which is set out in this work. As a rule, a bronchoscopic expert is an Ear, Nose and Throat specialist who has been specially trained in bronchoscopic procedure, more infrequently the lung specialists carry out bronchoscopic examinations themselves. All problems which touch the development of pulmonary tuberculosis or which deal with purely questions of tuberculosis have, therefore, been set aside in so far as they have no such intimate connection with purely bronchoscopic questions as to be necessary for the treatment. The investigation is therefore a purely clinical study of the results of bronchoscopy in pulmonary tuberculosis.

Most bronchoscopic examinations are made for diagnostic purposes, but in a number of cases bronchoscopic therapy is also resorted to. In these cases, to a certain degree, the curative results

in, first and foremost, tuberculosis of the bronchial mucous membrane, and to some extent in atelectasis, must be touched on. In addition, the healing of cavities by occlusion treatment is dealt with. Inconveniences, and especially complications, have been rather carefully examined, particularly with regard to dangers and narrow escapes during anaesthesia, as well as the treatment of these accidents. In many cases these dangers are not peculiar to bronchoscopy in pulmonary tuberculosis, but may arise in all cases of bronchoscopy. Their rôle, when considering contraindications, is, however, so great that the author has considered it suitable to treat these problems in this connection.

Indications for bronchoscopy should always be fixed by the lung specialist, and only on rare, exceptional occasions by the bronchoscopic expert, such as a desirable control or the wish to continue a treatment already begun. On the other hand, the bronchoscopic expert may fix contraindications, or, by reason of his experience and knowledge, reject bronchoscopy because in a certain case nothing is to be gained by a bronchoscopic examination.

The investigation is intended to give an answer to the question: Can bronchoscopy defend its position as a diagnostic and therapeutic aid in comparison with other means when it is a question of fighting pulmonary tuberculosis? Has the method great value when it is a matter of answering the different questions set by the lung specialist? Does the method entail so great detriment or danger to the patient that certain contraindications should be admitted in the carrying out of bronchoscopy?

The casuistic data are deposited in the library of the Ear Clinic at the Carolinska Hospital. In the text below will be found a short report of those cases which have a certain interest for our conclusions, or are related to the question. They are provided with a number corresponding to the number in the deposited casuistics.

CHAPTER I

Historical Survey.

The discovery of bronchoscopy increased the possibilities for the study of changes in the trachea and the greater bronchi. It was not until many years after the discovery had been made that the procedure was adapted as a method of examination or of assistance in the treatment of tuberculous diseases of the lungs or of the greater air passages. During the first decade, in fact, efforts were almost entirely directed to the treatment of foreign bodies in the air passages, and later to the diagnosis of tumours in the lungs and air passages. As late as 1928, when Yankauer spoke on bronchoscopy before the American Bronchoscopic Society at its yearly meeting, bronchoscopy in pulmonary tuberculosis was hardly mentioned. On the other hand, the importance of bronchoscopic examination in hemoptysis was brought out. When v. Eicken in 1939 made a survey of his activity as a bronchoscopist over a period of 40 years, he did not say a single word about bronchoscopy in pulmonary tuberculosis. Before 1930, he points out, bronchoscopy was most used for the extraction of foreign bodies, at least in European clinics. During a journey for purposes of study, however, he noticed that Jackson's clinic in America, amongst others, had early used bronchoscopic examination mostly for other reasons (2 % foreign bodies, 98 % other indications).

Sporadic peroral bronchoscopy in pulmonary tuberculosis was carried out in 1928 (Myerson) but before 1930 otherwise hardly any bronchoscopic examinations were carried out on tubercular patients (Cohen and Wessler). Myerson made the same remarks, amongst others, that year. He considers, however, the year 1932 as the decisive year for the introduction of bronchoscopy in the diagnosis and therapy of pulmonary tuberculosis. Soulas used bronchoscopic examination in pulmonary tuberculosis and considers it to be an enormous achievement and of great benefit, when this method of examination was introduced with regard to pulmonary tuberculosis. The development progressed further, and the 1930s were the decisive years all over the world for bronchoscopy in cases of pulmonary tuberculosis, both

in diagnosis and therapy. The importance of bronchial complications to the course, and above all to the cure, of pulmonary tuberculosis was realised. Most lung specialists now make use of bronchoscopy. As a rule they do not carry out the examination themselves, but rely on a bronchoscopic expert for these examinations.

Meyersburg, Gruber and Lupo pointed out in 1942 that until a few years ago, pulmonary tuberculosis was held to be an absolute contraindication to bronchoscopic examination by most authors. Many lung specialists have, however, since then altered their views and now advise bronchoscopic examination in active pulmonary tuberculosis. Nowadays it is considered absolutely necessary to carry out a bronchoscopic examination for a satisfactory diagnosis of bronchial complications. From a therapeutic stand point, bronchoscopy is of great importance.

Bronchoscopy of tubercular patients was feared, says Schubert, since it was considered that bronchoscopic examination had an unfavourable influence on the tubercular processes. Most tuberculosis specialists have now got over this point of view, since with improved technique and greater manual dexterity in the bronchoscopist there has been shown to be little risk. To ensure the diagnosis and especially the localisation of bronchial complications, bronchoscopy is often very necessary.

Limoine and Diacoumopoulos announced in 1944 the result of 2,500 bronchoscopic examinations of pulmonary tubercular patients, and these authors emphasize that bronchoscopy is the only sure method of diagnosing tuberculosis of the mucous membranes of the trachea or bronchi during life.

The superiority of bronchoscopy over other methods of diagnosing diseases in the bronchi and the trachea is now vouched for in many directions (Hollingsworth, Leegaard, Smidt, Wessling). Increased experience of bronchoscopy has caused this method to be more and more taken into account in bronchial complications even in pulmonary tuberculosis, and also for differential diagnosis problems in the speciality which pulmonary tuberculosis represents (Baron, Dahlstedt, Frenckner, Leegaard, Lund-Johansen, Richel, Smidt, Soulas). Lecœur and Mathey describe confused lung cases in which it was not possible to decide if it was a question of malignant tumour

or other disease, and which were revealed as tuberculosis after bronchoscopy with a test excision. Shipman also describes 3 cases which could not be diagnosed without the help of bronchoscopic examination. Quite early on the superiority of this method over all others had been established in the observation of bronchial complications in pulmonary tuberculosis (Mastbaum and Troutuev 1934).

Rosenqvist sums up the importance of bronchoscopic examination in pulmonary tuberculosis as follows: it is possible 1) in patients with pulmonary tuberculosis to show tuberculous processes in the trachea and the bronchi which may be of great importance in the treatment of pulmonary tuberculosis, 2) eventually to show tuberculous processes in the trachea and the bronchi as an independent localisation (they are rare), 3) to refute a diagnosis of tuberculosis in hemoptysis, where a clinical and X-ray examination of the lungs gives no sure grounds for a tubercular process, and where bronchoscopy shows that the bleeding proceeds from, for example, a broken vessel in the mucous membranes, 4) to treat tuberculosis of the bronchial mucous membranes, which may be of importance later for possible treatment by pneumothorax or other collapse methods.

At present therefore the developments point to an increased use of bronchoscopy in diagnostic work in diseases of the lungs. Recently, however, the therapeutic work with bronchoscopy has suffered a set-back since the introduction of PAS and streptomycin for the treatment of bronchial complications in pulmonary tuberculosis. Local treatment has thus lost some of its importance and is carried out on a considerably smaller scale than heretofore.

CHAPTER II

Material.

The investigation comprises a material which was sent by the sanatorium doctors of the Norrbotten Province Central Sanatorium for bronchoscopic examination. The sanatorium is the reception centre for the whole province of Norrbotten, Sweden's northernmost province, with a population numbering 234,595 in 1947.

Reception figures at the Central Sanatorium were as follows:

1944	men	526	women	513	total	1,039
1945	„	577	„	626	„	1,203
1946	„	522	„	611	„	1,133
1947	„	194	„	192	„	386
(up to 31/8)						
Total	men	1,819	women	1,942	total	3,761

The percentual division of men and women among those received was men 48 %, women 52 %. The corresponding division with regard to the patients examined bronchoscopically was 47 % men, 53 % women, i.e. the same division.

Cases for bronchoscopic examination are selected by the sanatorium doctors from among the patients for whom a bronchoscopic examination is considered to be indicated. Only in a small number of cases has an examination been requested by the bronchoscopic expert, and that in cases which for one reason or another have been considered to need a control bronchoscopic examination or in order to continue treatment. The material investigated includes the period from 1/1 1944 up to and including 31/8 1947. During this time the sanatorium was directed by the same head doctor, so that the indications have been to a great extent uniform, with the exception of those changes which widened experience gave rise to.

Altogether 1,001 bronchoscopic examinations were carried out on the material investigated of which 428 on male patients and 573 on female patients. The total number of patients who were bronchoscopically examined during the said period was 420, of which 201 were males and 219 females.

From the figures quoted, it has been possible to draw the conclusion that the division of patients bronchoscopically examined agrees with the number received, while the division of bronchoscopic examinations shows a certain leaning towards the women's side. The latter fact has been interpreted as a coincidence that control bronchoscopic examinations have occurred more frequently among the female clientele. Of the whole clientele received, broadly 11 % have been selected for bronchoscopic examination.

Besides the pulmonary tuberculosis material proper, in a hospital for tuberculosis there are always a certain number of cases of lung trouble for investigation. These consist of cases of atelectasis, hemophthisis, suspected changes of the parenchyma, lymph adenitis etc.:. In a number of these cases bronchoscopy has had to be carried out in order to fix the diagnosis or to exclude a diagnosis of tuberculosis. These cases are included in the material, since they have a certain interest in this conjunction. The investigation would not be complete either if these were excluded. They are, however, so few in number that they do not, for example with regard to complications, disturb the figures, but these can, broadly speaking, be compared with purely tuberculosis material.

A survey of the material has shown that of the total 420 patients examined, there was found

Specific bronchitis in	71 cases, 17 % of the material
Suspected specific bronchitis in	62 „ 15 % „ „ „
Unspecific bronchitis in	52 „ 12 % „ „ „
Clinical atelectasis finding with positive bronchoscopy	
finding in	46 „ 11 % „ „ „
Bronchostenosis in	79 „ 19 % „ „ „
Valve mechanism with pos: bronchoscopic finding in	6 „ 1.3 % „ „ „
Lymphadenitis with perfora- tion in	5 „ 1.2 % „ „ „
Hemophthisis, all with negative	
Bronchial cancer	6 „ 1.3 % „ „ „

These different findings will be dealt with later in other sections.

A purely routine investigation was made by McIndoe, Steele, Samson, Anderson, Leslie, carried out on 272 sanatorium patients with no selection.

The following results were obtained

Tubercular bronchial changes	in 30 cases, 11 %
Suspected tubercular bronchial changes	in 13 cases, 4.9 %
Distortion, kinking or scarring	in 21 cases, 7.9 %
Non-tubercular bronchitis	in 30 cases, 11 %
Bronchial cancer	in 1 case, 0.4 %
Negative finding	in 177 cases, 64.8 %

These two reports are not entirely comparable, since one material was to a certain degree chosen on account of clinical suspicions of one complication or another, but the other material is a cross-section of sanatorium material.

CHAPTER III

Technique.

As a preliminary treatment before bronchoscopic examination, a subcutaneous injection of 0.15 gm. phenemal is given one hour before the operation. The anaesthesia itself is carried out with the following solution:

Tetracain hydrochloride	gm. 40
Methylene blue	„ 0.015
Distilled water	to „ 2,000

The blue colouring is only added to the solution for the purpose of avoiding confusion of it with other similar solutions. Before using this 2 % solution a few drops of rhimidol are added to the quantity to be used (3 ml.).

Anaesthesia is produced as follows: the mucous membrane of the pharynx is numbed by spraying with the said solution 3—4 times. Thereafter, 1 ml. of the solution is sucked up into a laryngeal syringe and dropped on the vocal cords slowly while the patient intones. Thereafter 1 ml. is dropped in with the patient sitting and leaning over markedly to one side, and then 1 ml. with the patient leaning over to the other side. During the injection of these last two doses, the patient holds the vocal cords in the position of rest, that is open. After a pause of about 10 minutes, the operation may be carried out. The anaesthesia has as a rule been good, except in those cases which had an abundant secretion from the bronchial tree. In these cases it has sometimes been necessary to give an adrenaline or scopolamine preparation in conjunction with the phenemal injection.

In rare cases, ether narcosis with an open mask has been used. This has been exclusively in the bronchoscopic examination of children under 10—11 years old. Local anaesthesia has always been successful in bronchoscopy on older children, but the dose has been reduced somewhat in proportion to the normal doses mentioned above.

The bronchoscopic examination has always been carried out in

the lying position on an operating table and with the aid of a head rest constructed by Frenckner—Öhngren—Stille. This head rest has the great advantage that it can be exactly manoeuvred by the operator or by an assistant without any effort, and always in such a way that it is not necessary to strain with the bronchoscope itself. The operation is therefore, with the help of this support, very little damaging to the bronchial mucous membranes.

As an instrument for bronchoscopy, the Roberts bronchoscope has always been used. In all normal cases, a 40 cm. long tube is used 11 mm. in diameter. This size permits a very good view and also allows the introduction without difficulty of the different instruments used for carrying out endobronchial operations. Only in the bronchoscopic examination of small individuals or of children has a bronchoscope of smaller size been used. Generally, a laryngoscope has not been used in bronchoscopy otherwise than for examining small children under narcosis. A Jackson laryngoscope with a detachable front piece has then been used.

A prograded magnifying glass, Zeiss-Kollmargen model, 40 cm. length and 5 mm. diameter has been used in the majority of cases, and always when it was a question of diagnosis of a change in the bronchi or in the trachea.

Of the other accessories which have been used, mention may be made of test excision forceps, also of the flexible kind, foreign body grips, sounds, numbing forceps, straight and flexible aspirating tubes. In silver nitrate cautery, a tuft of cotton wool is firmly wound round a sound. For cauterizations, a galvano-caustic cauterizer on a long shaft has been used which is introduced through the bronchoscope. The cauterizer was broad for surface cautery and pointed for deep cautery or cautery in points.

The silver nitrate solution used was 50 % in those cases where necrosis of the bronchial mucous membrane was required. For the cautery of surface granulations, a solution of weaker concentration was used, sometimes as low as 10 %.

To the technique of bronchoscopy belong also technical complications. Guida divides the complications in bronchoscopy into three groups: 1. During anaesthesia, 2. during the bronchoscopic examination, and 3. after the intervention (he here quotes Forbes). Of these different complications, the first two groups belong to the technical complications, and they may occur either when it is

a bronchoscopic examination of a patient with pulmonary tuberculosis or a patient with some other disease. They are therefore now treated in connection with the technical procedure.

Guida points out further that it is important that the bronchoscope should be well suited in size to the bronchial tree, and that it should not be held at an angle to the direction of the trachea. According to Jackson, practically speaking, there is no need for complications to arise. Sharp and Gorham consider bronchoscopy as a harmless operation. Lemoine and Diacoumopoulos state, in an investigation of 2,500 bronchoscopic examinations, that the examination causes no notable inconvenience to the patient in spite of the fact that it was formerly considered to be a damaging method of examination.

The complications in the first group are those which occur during anaesthesia or because of it. The local anaesthetic which is used for numbing in bronchoscopic examinations is a protoplasm poison with a special affinity for the nerve tissue. If they are rapidly absorbed, even small quantities of these solutions may produce a toxic effect. The abundant vessels in the pharynx membrane predispose it to such absorption to a high degree.

From the experimental investigations on animals by Tatum, Atkinson and Collins it is known that barbituric acid preparations reduce to a great extent the toxicity of cocaine. The experiments were continued and they were able to save animals suffering from cocaine poisoning by large doses of barbituric acid preparations.

Nowadays, cocaine is used very sparingly as a numbing medium. It has, however, been found that even with the use of local anaesthetics of the etocaine type, which to-day are the most usually used for numbing in bronchoscopy, narrow escapes and even fatal cases have occurred. Even with very small doses, fatalities may occur.

The symptomology of these poisonings is quite uniform, independent of which kind of these kindred preparations is used for the anaesthesia. The patients become pale, feel ill and seem not quite clear-headed. This symptomatic picture may arise already after having sprayed a negligible quantity of the anaesthetic on the pharynx. The symptoms may subside or they may also develop, with excitation, delirium and later convulsions and cramps. If no

treatment is undertaken, the patient may go *ad mortem* in these cramps. It is even more treacherous when the reaction first sets in after 10—15 minutes; the patient has then received the entire quantity of the anaesthetic solution and thereby becomes seriously poisoned. It is therefore necessary to keep an early watch for any signs of intoxication.

Gordh has furnished an excellent report on the primary treatment of these intoxicated patients, and states that in most cases it is possible to save even those who suffer from the most dangerous complications. I take the liberty of quoting Gordh's treatment procedure:

Primary measures.

1. The head end is lowered.
2. Oxygen.

Secondary measures.

3. Intravenous stimulation.
4. Fluid, blood.

The treatment which has been tested in anaesthesiology is the following:

In mild symptoms (pallor, indisposition, cold sweat, tremors):

1. Lower the head end so that the upper portion of the body is lower than the lower part. Raise the legs.
2. Give continuous inhalations of oxygen.

In serious symptoms (unconsciousness, collapse of the circulation, wide pupils, stoppage of breathing, cramps):

1. Lower the head end.
2. Give immediate artificial respiration with oxygen. A free air passage to the lungs is an absolute requirement. Use a pharyngeal tube. Intratracheal insertion of the tube is the safest.

The oxygen treatment can be given with the narcosis apparatus, or, if this is not available, with a smaller oxygen apparatus, for example a portable Salvator. If no oxygen is at hand, the method of artificial respiration which is best known to the operator is practised. It must be emphasized that ordinary artificial respiration is much inferior to oxygen treatment. In convulsions: —

- 1 and 2 as described above.
3. Give superficial intravenous narcosis with barbituric acid

derivative (narkotal, evipannatrium or such like). The action in this therapy consists in the fact that the intravenous narcosis medium produces a functional decerebration in the region of the pons. By means of this the motor impulses from the centres situated higher up are interrupted and the cramps cease. The similarity between anatomical and functional decerebration with intravenous narcosis has also been shown by experiments on animals. (Gordh 1945.)

As has been said before, it has been experimentally shown that the toxic dose of cocaine is higher if simultaneous administration of a barbituric acid derivative is made. This has also shown itself to be true of preparations of the etocain group (Tatum). This circumstance has been exploited for prophylactic purposes in that, before the commencement of the numbing for bronchoscopy, the patient is given a barbituric acid derivative, in the case of our patients 0.15 gm of luminal injected one hour before the examination. It has been found clinically and experimentally that stimulants are without effect on the breathing in these cases.

In our own cases we have had 4 cases of toxic symptoms. However, we have not counted lesser toxic symptoms such as light delirium or a feeling of indisposition, as such were not noted down. In these cases it has been difficult to differentiate purely psychic from toxic symptoms. The greatest precautions have, however, always been observed, even in these cases, when anaesthesia was continued.

A short account of the 4 toxic cases follows:

Case 125. Woman, 34 years. Sent for bronchoscopic examination because of suspicions of bronchial stenosis in the upper lobe. She received a numbing spray of 1½ ml. 2 % tetracain solution plus a few drops of rimidol on the pharynx, and as an injection in the trachea and bronchi. Before the conclusion of the numbing, she became indisposed and slightly unconscious, but recovered after a short time so that the examination could proceed.

Case 389. Woman, 24 years. Bronchoscopy had been carried out 4 months earlier for an atelectasis in the right upper lobe. The numbing was performed without any complications. When she was to be examined again, already after spraying of the pharynx with 1½ ml. 2 % tetracain solution with a few drops of rimidol, she became unconscious and universal cramps set in. After one hour's artificial respiration and oxygen treatment, the patient was able to breathe herself, and after a further 2 hours she recovered consciousness. After 2 days the patient had recovered. The bronchoscopic examination could not be carried out. Later the patient fell into a psychic depression.

Case 104. Woman, 27 years. During a period of 2 years she had been examined bronchoscopically 3 times on account of an atelectasis and a pressure cavity. The numbing had always been carried out without any complications.

Occlusion treatment had also been begun. When she was to be examined for the fourth time, already after spraying the throat with 1½ ml. of 2 % tetracain solution with a few drops of rimidol, she became delirious and lost consciousness for a short while. There were no cramps. We were ready to continue the numbing, but the patient refused further treatment so it was discontinued.

Case 96. Woman. 23 years. Had formerly been hospitalized for tuberculosis of the pleura and the peritoneum. At the time of the accident she had an ulcerating tuberculosis of the bronchial mucous membrane with stenosis in one main bronchus. She had been examined on 4 different occasions during the course of 6 months before this last bronchoscopic examination. There had been no complications during the numbing. On the fifth occasion, however, after spraying the throat with 1½ ml. 2 % tetracain solution with a few drops of rimidol, she almost immediately became unconscious, and universal cramps set in. She was treated with artificial respiration and oxygen but death supervened with the cramps after 1/4 hour. The post-mortem showed widespread tuberculosis of the intestine in addition to the bronchial tuberculosis.

These four accidents belong to the earliest bronchoscopic examinations, and the patients had not been given luminal prior to the operation. Nor was anything then known of the life-saving properties possessed by an intravenous injection of a barbituric acid derivative. These patients therefore did not receive narkotal intravenously which might perhaps have saved the patient who died. After this experience and this accident, all patients receive luminal prior to the operation, and narkotal is always at hand in the operating theatre, for intravenous use.

To the technical complications previously pointed out belong the second group of complications, those which arise during the bronchoscopic examination itself. Cory describes an uncommon one. He speaks of a case of bronchoscopy which suffered a lesion of a vessel in the mucous membrane of one main bronchus. An air embolism followed in the brain, and the patient died 2 3/4 hours later. Other, more ordinary injuries are mentioned by Smidt. They consist of injuries to the teeth, especially when the teeth are large and prominent.

With a certain amount of practise and by taking precautions, complications in bronchoscopy should be able to be reduced practically to nil. The teeth always constitute a certain danger. In one case a lesion of a heavily decayed tooth occurred, and in one case there was damage to a crowned tooth with a decayed root. Healthy teeth should not suffer damage if too much force is not used in manoeuvring the bronchoscope.

In certain cases small haemorrhages have occurred, especially in those cases where the patient has been very agitated and has

not been able to be persuaded to lie still during the examination. The haemorrhages have never been so copious as to play any rôle in the carrying out of the examination, and have therefore not been recorded as complications in bronchoscopy.

No technical difficulties in carrying out the bronchoscopy itself have ever arisen. In those cases where the patient has been agitated, it has, however, caused the patient a lot of trouble in the shape of pressure on the pharynx and larynx. Necrosis has never occurred.

The basic condition for a successful carrying out of a broncoscopic examination is satisfactory anaesthesia.

CHAPTER IV

Nomenclature and consultation procedure.

Bronchoscopy is not an independent science, but is an aid to lung diagnosis and the treatment of lung diseases. The work is therefore divided between the lung specialist, who is generally principally responsible to the patient, the roentgenologist and the bronchoscopist, both the latter as consultants to the lung specialist. So that cooperation may be easy, and misunderstandings excluded as far as possible, it is very important that all these specialists should use the same nomenclature. This unfortunately has not been the case hitherto. It is evidently desirable that final conclusions should be reached at international congresses, and that agreement should be reached on the nomenclature to be used with regard to the bronchial tree and the different parts of the lungs.

A proposal has been made by Leegaard to classify the different bronchi according to the part of the lung to which the respective bronchi lead. Proposals have also been set forth by Huizinga and Kassay and both these proposals agree in principle with that made by Leegaard. Broadly speaking; the only difference is in the nomenclature itself. Soulas and Mounier-Kuhn have also proposed a nomenclature which is based upon the branches of the bronchi. The corresponding parts of the lung receives the same name as the bronchus which supplies it, for example upper lobe, apical, anterior, posterior and so on. The most important thing is then that the lung specialist, the roentgenologist and the bronchoscopist should know to which part of the lung the different bronchi lead. It is in fact possible to get an idea from the roentgen picture of which bronchus it is that leads to a certain part of the lung. Clear and simple terminology is not only of importance in avoiding misunderstandings, but is also an abridged indication of a certain part of the lung with its accompanying bronchus.

Another nomenclature, which varies from author to author, is the naming of the different bronchi in general. Alexander has followed the nomenclature given by W. Felix: main bronchus on

the right and left side, the bronchi of the respective lobes, for example the upper lobe bronchus, the middle lobe bronchus, the lower lobe bronchus and the branch bronchi of the 1st, 2nd rank etc;. This nomenclature seems to be particularly adequate and excludes the possibility of mistakes, so that it has been followed in the present investigation.

An important branch of all consulting work is the consultation procedure. This is true to an especially high degree when it is a question of bronchoscopic consultation cooperation. The best thing is, without doubt, that the lung specialist himself should be present when the bronchoscopic examination is carried out. But even if he is present, before the operation is undertaken, he should be quite clear as to the different questions he requires answered positively and negatively. Without such clarity there is no grip on the indication for bronchoscopy. For example, a specific process in a determined part of the lung may be suspected and supported by clinical findings or roentgen examination. A fixed terminology must therefore be used, which should be laid down for all doctors who are occupied with the examinations. Another example is routine bronchoscopy in which it is desirable to have a check that no changes are present.

CHAPTER V

Indications and contraindications.

Indications:

In the course of the years, indications have widened to a notable extent in bronchoscopy in pulmonary tuberculosis. According to Meyersburg, Gruber and Lupo, only a few years ago pulmonary tuberculosis was considered a contraindication to bronchoscopy by most authors. Many lung specialists have since changed their views and now advise bronchoscopy in active tuberculosis. Nowadays it is considered inevitable that a bronchoscopic examination should be carried out in order to make a satisfactory diagnosis of bronchial complications. Also from a purely therapeutic point of view bronchoscopy is of great importance. Lecœur and Mathey use bronchoscopy in confused lung cases where it is impossible to decide if it is a case of malignant tumour or of another disease. Occasionally it has been possible in these cases to establish bronchial tuberculosis after a test excision.

Mc Indoe and others carried out a comparative investigation on the clinical, roentgenological and bronchoscopic findings. Nearly $\frac{1}{3}$ of the cases showed clinical signs of tuberculosis of the trachea or bronchi, but only in $\frac{1}{3}$ of these cases was an affection of tuberculous nature found. These authors came to the conclusion that the clinical symptoms arouse suspicions of tracheo-bronchial tuberculosis so that routine bronchoscopy without clinical symptoms is of very little value.

Rafferty and Shields fix as indications for bronchoscopy in pulmonary tuberculosis: 1. Wheezing; 2. Cyanose or dyspnoe without demonstrable cause; 3. Severe coughing or sputum which is difficult to get up; 4. Positive sputum finding without demonstrable cause; 5. Greater symptoms than the extent of the disease should produce; 6. Notable variations in the character or quantity of the sputum; 7. Lobar atelectasis; 8. Roentgen finding of lymph shadows or a concentration of the disease in the lymphatic region.

Myerson's indications for bronchoscopy are: 1. Routine examination before thoracoplasty; 2. Persisting tubercular bacilli in spite of satisfactory collapse after pneumothorax or thoraco-

plasty; 3. Wheezing, heavy breathing; 4. Unexplained atelectasis; 5. Bacilli without explanatory lung finding.

Baron points out the importance of bronchoscopy before undertaking a pneumothorax.

Morlock gives the following indications: 1. Negative sputum cases. 2. Cases with emphysema. 3. Cases with collapsed lung parts. 4. Suspicion of specific tracheo-bronchitis. 5. Cases where another disease of the lungs is suspected.

Lund-Johansen sets up as indications for bronchoscopic examination in pulmonary tuberculosis: 1. Symptoms which might point to bronchial tuberculosis. 2. Positive bacillus finding in spite of good collapse of the lung. 3. Tubercular bacilli of uncertain origin. 4. Atelectasis before or after the commencement of collapse treatment. 5. Suspected pressure cavities. 6. Routine examination before thoracoplasty or pneumolysis.

Rischel gives as indications for bronchoscopy: 1. Prior to every thoracoplasty. 2. Atelectases of different extent or suspicions of the same. 3. Cavity obstruction. 4. Hemophtysis. 5. Positive bacillus finding by minimal or older processes. 6. Positive bacillus finding in spite of good collapse. 7. Signs of bronchitis, stridor or dyspnoe. According to information given by Crafoord, Hawkins advises bronchoscopy in every case of pulmonary tuberculosis which is to be the objects of a surgical intervention.

As may be seen from the examples selected from the textbooks, indications for bronchoscopy are now comprehensive and on the whole quite agreed upon by the various authors. Isolated authors (Sharp and Gorham) even consider that a bronchoscopic examination should be carried out prior to every kind of collapse treatment, except thoracoplasty and pneumothorax as well as obstruction of the phrenicus and the pneumoperitoneum, in order to ensure that no form of tuberculosis of the bronchial mucous membranes is present, this applies to both fresh cases and stenosis.

Our own indications have been comprehensive. They have been fixed by the lung specialist more in the shape of a questionnaire to the bronchoscopist than as a proper list of indications. In this way the indications have been:

1. Lymphadenitis with eventual perforation.
2. Suspected specific process in the bronchial tree.

3. Suspected stenosis.
4. Valve mechanism.
5. Atelectasis.
6. Hemophthisis of doubtful origin.
7. Occlusion treatment.
8. Treatment by aspiration.
9. Secretion tests, either to decide from which side the bacilli come, or to obtain secretion for culture in negative sputum cases.
10. Questions concerning differential diagnosis.
11. Routine examinations before carrying out pneumothorax thoracoplasty, pulmectomy or lobectomy.

Contraindications:

To-day, bronchial or tracheal tuberculosis is not considered as a contraindication to bronchoscopy (Meyersburg, Gruber and Lupo). Myerson puts forward as direct contraindications:

1. Laryngeal tuberculosis.
2. Fresh hemophthisis.
3. Debility.

Rischel notes the following contraindications: 1. Extensive laryngeal ulceration. 2. A healed but much constricted larynx. 3. Debility.

A patient who is deeply impressed usually tolerates bronchoscopy badly; he is especially influenced by the numbing (see complications). We have also been chary of carrying out bronchoscopic examinations in extensive laryngeal tuberculosis. This is connected with the fact that just those patients are often deeply impressed by their illness. A certain caution has also been observed with patients with a big extension of the parenchymal processes.

Our contraindications therefore are:

1. Deeply impressed patient.
2. Extensive laryngeal tuberculosis.

CHAPTER VI

a. Lymphadenitis with eventual perforation.

The question has sometimes been put by the lung specialist as to whether endobronchial signs of lymphadenitis were present, either by a compression of the bronchial wall or a perforation of a gland. A mass discharge of bacilli may have, in fact, taken place without a corresponding change in the lung parenchyma.

As a matter of curiosity, it may be mentioned that Soulas and Mounier-Kuhn in their excellent book "Bronchology" say that Erdely in 1906 and Schmiegelow in 1908 described perforations of lymphadenites into the bronchial tree which they had observed by so-called lower bronchoscopy through a tracheotomy opening. First in 1922, Paunz demonstrated by means of peroral bronchoscopy such a perforation from an adenitis into the bronchial tree.

Dufort and Mounier-Kuhn also maintained that fistulas caused by lymphadenites from the lymphatic region into the bronchial tree were more common than had formerly been believed. Usually the fistula opening is very small, sometimes only as big as a pin's head. The fistulas may, in addition, occasionally remain latent and close of themselves, but later they open again for a certain time. They may then empty themselves in bulk of a secretion containing bacilli; this secretion often has quite the consistency of cheese. Westergren has even noted cases where pure chalk emptied itself from such fistula openings. The fistulas may heal spontaneously with or without scarring of the bronchus.

Myerson points out that lymphadenitis, even before it perforates, gives rise to bronchostenosis although this is comparatively rare in adult patients. The danger is, however, he points out, that it may produce pressure necrosis in the bronchial wall and secondary shrinking of the bronchus. Wissler also describes 3 cases of lymph perforation which accompanied total atelectasis of the lung. The cause of the atelectasis is probably the great damage to the bronchial wall through pressure necrosis with consequent heavily marked bronchostenosis.

Leegaard announced a case of a unilateral bronchitic picture

from an endobronchial examination which showed itself to be a perforated lymphadenitis, probably of tuberculous nature.

Paunz states that the commonest place for perforation of a lymphadenitis in children is the lowest part of the trachea above the right main bronchus, or immediately under the point of departure of the right or left main bronchus. The perforations are easily accessible to inspection through the bronchoscope, points out Paunz. Moorhead has described a case of tuberculosis of the bronchial mucous membrane in a 17 months old patient, who underwent a bronchoscopic examination on 2 occasions. On microscopic examination after a test excision, it proved to be tuberculosis. It appears probable that it was a question of a tubercular gland which had perforated.

The passage for infection to a lymph gland of hilus goes via the throat organs, the lymph glands of the throat, the paratracheal lymph passages and so to the lymph glands of hilus. A previous infection of the lung parenchyma is not necessary, as is maintained by Westergren, Hedman and others. Westergren has also described cases of perforations by glands partly into the bronchial tree and partly into the oesophagus. Cases have even occurred of a fistula from the bronchial tree into the oesophagus arising from a perforated adenitis. Diverticula in the oesophagus have also arisen through adenitis perforation according to Westergren.

My own investigations.

21 cases of suspected lymphadenitis with or without perforation had been sent for examination. During the period included in the investigation, 232 cases were hospitalized at the sanatorium with a diagnosis of lymphadenitis, and there were in addition 193 cases with a diagnosis of primary pulmonary tuberculosis. The latter are not always clearly differentiated from the former, but should be taken together in the same group. Thus a group of 425 with a roentgenological diagnosis of lymphadenitis is obtained. Of these, as has been said, only 21 were bronchoscopically examined, i. e. not quite 5 % of the whole lymphadenitis material. The investigation cannot therefore provide evidence of how this material behaved under bronchoscopic examination.

The material investigated was chosen from among the lymph-

adenitis patients by sending for bronchoscopy those cases which, clinically or roentgenologically, could be suspected of some bronchial complication. Lymphadenitis with complications may be suspected clinically when atelectasis peripheral to the adenitis is present, or when there is some other sign of bronchostenosis. A perforating adenitis is suspected when a roentgen examination has shown a lymphadenitis and no, or only very slight, changes of the parenchyma, but suddenly a positive bacillus finding is obtained.

Of all the cases examined, 3 showed a slight constriction of the bronchus, which was interpreted as depending on pressure from a lymphadenitis which had not yet perforated. In 5 cases perforations were present with open fistulas into the bronchial tree. Two were situated in each main bronchus, and one in the lower lobe bronchus. In one case, bilateral fistulas were present. There were 3 cases of specific bronchitis with stenosis, and in these cases it was not possible to decide if an adenitis perforation was the original cause of the tuberculosis of the bronchial mucous membrane. In 10 cases, i. e. in half of the cases, the bronchoscopic finding was negative. These statistics are certainly very small and not conclusive, but looked at in comparison with those given by Soulas and Mounier-Kuhn for a series of 148 cases of "primosecondaire" infection bronchoscopically examined, with 18 cases of compression and 54 of fistulas, they are quite in agreement.

In spite of the fact that very much enlarged lymphadenites may be shown roentgenologically, compression of the bronchial tree is seldom present. It is highly probable that great force is required to compress the hard bronchial wall. In addition, the bronchus may be displaced laterally or forwards or backwards into the soft lung parenchyma. Presumably the pressure influence must be of such a kind that swelling of the mucous membrane and necrosis to a greater or lesser degree combine in order to give rise to more pronounced constriction.

Continued observation of those patients who had positive findings with bronchial fistulas from lymphadenites show that 1 healed without stenosis, 2 healed with stenosis, 1 healed intermittently but with stenosis and the 5th did not heal, but stenosis was present.

Recognition of a lymphadenitis perforation is a highly important detail both from a diagnostic and a prognostic point of view. The perforation is quite accessible to the range of the bronchoscope and is usually free from the bronchial orifices, so that generally there is no difficulty in distinguishing it from a tubercular cavity. With a view to diagnosis, the fistula can easily be sounded, sometimes up to 2—3 cm. In many cases, so-called primary tuberculosis of the bronchial mucous membrane is probably caused by a perforated lymphadenitis. An atelectasis, arising unforeseen, may in 2 of the above mentioned cases have been caused by a gland perforation.

Discussion: Lymphadenites are generally of great interest to the clinical worker, but are relatively little known to the bronchoscopists. Those lymphadenites which present no complications in the form of atelectasis or other symptoms of stenosis, no symptoms of perforation and which do not obtrude themselves particularly by reason of their size, are usually not examined bronchoscopically either. It is also striking that in the material of McIndoe and others, not a single case of lymphadenitis was dealt with. This material was routine work without any selection. In those cases where clinical suspicions of an adenitis perforation exist, bronchoscopy is as a rule carried out with positive findings in many cases. It seems hardly probable that, in routine bronchoscopy on every tuberculous patient, a positive finding would more frequently be found in lymph tuberculosis if the patient has no clinical or radiological signs of a complication to his lymphadenitis.

Lymphadenites often present a bronchoscopic picture which it is easy to recognize, especially if a perforation is present. The perforation in many cases leads to necrosis of the bronchial wall and then to bronchostenosis, generally in the main bronchus. This stenosis often becomes high-grade, and leads to complications behind the stenosis.

The so-called primary tuberculosis of the bronchial mucous membrane must in many cases be a lymphadenitis which has perforated. From a therapeutic point of view amongst others, there is a certain importance in being able to distinguish these forms, that is the perforated adenitis and tuberculosis of the bronchial mucous membrane by extension from the lung parenchyma.

b. Tuberculosis of the bronchial mucous membrane

By tuberculosis of the bronchial mucous membrane is meant tuberculosis in the mucous membrane itself, and in those parts of the bronchial wall which lie nearest to the membrane itself. No distinction is made as to whether this tuberculosis arose through a process lying beneath the mucous membrane and working itself up through the same, or through a process which enters from the surface of the mucous membrane and penetrates in depth.

Already in olden times tuberculosis of the bronchial mucous membrane was known, before the discovery of the tubercular bacillus. However, interest had not been directed towards this localisation, but was concentrated rather on the disease in the lung parenchyma. In recent years, however, more and more attention has been paid to the great importance of the part which bronchial tuberculosis plays as a complication to pulmonary tuberculosis proper.

The incidence of tuberculosis of the bronchial mucous membranes is given very differently by different authors. Thus Crafoord, according to Hebecke-Lurbasch, says that tuberculosis occurs in the bronchi in 4 % of all cases of pulmonary tuberculosis. Dahlstedt gives the incidence as 20 %. Huang states that in post-mortem material consisting of 115 cases of pulmonary tuberculosis, tuberculosis of the trachea and bronchi occurred in 42.7 %. Jenks points out the great variation in frequency with regard to the incidence of tuberculosis of the tracheo-bronchial mucous membranes, and in the text-books he found variations of from 41 % — 3.1 %, Berblinger found in a post-mortem series of 206 cases of pulmonary tuberculosis, tuberculosis of the tracheo-bronchial mucous membrane in 4.85 % cases, and Flance and Wheeler on similar material of 285 cases, 3.1 % (9) cases of tuberculosis of the bronchial mucous membrane. Hawkins J:r, on a series of 516 bronchoscopically examined patients, demonstrated tuberculosis of the bronchial mucous membrane in 132 cases (25.6 %). Jacob and Lemoine say that about 7 % of all cases of pulmonary tuberculosis have complications from the trachea and the bronchi. It naturally depends on the material, but also on whether macroscopic examination only is made, or if microscopic examination is also carried out. A notable variation is

also certainly produced according to whether the material used is living or post-mortem material. If living material is used, the only possible method of examination is bronchoscopy. Variations also naturally arise according to whether a cross-section of all the patients with pulmonary tuberculosis are sent for bronchoscopy, or only those patients who are clinically suspect. A very important circumstance is also whether the tuberculosis is in an early stage or whether it is far advanced. The latter is, as a rule, post-mortem material, so that the result of the examination on such material may always show a higher percentage with regard to the incidence of tuberculosis of the tracheo-bronchial mucous membranes. Lemoine combines the various statistics in such a way that tuberculosis of the bronchial mucous membrane is a relatively common complication which is difficult to diagnose clinically, but easy bronchoscopically.

Most cases of bronchial tuberculosis are secondary to processes in the lungs (Rischel), and arise through extension from cavities. Hematogenous ruptures are stated by Rischel to be rare, although the way of implantation is the most common. Westergren remarks that endobronchial tuberculosis and bronchostenoses arise mainly, so to speak, from below via the lymph passages. Kernan maintains that it is still debatable which channel of infection is the commonest in tuberculosis of the bronchi, the lymphatic or the direct. A number of authors incline to the first view and others to the second. This question cannot yet be answered. A number of cases of bronchial tuberculosis arise through perforation of lymphadenitis (Myerson & others).

Cases have also been described of primary tuberculosis of the bronchial mucous membranes. Jacqelin and Villanova, like Steiner, describe such cases. Leegaard suggests that tuberculosis of the bronchial mucous membrane is usually secondary to parenchymatous changes, but extensive tuberculosis of the bronchial mucous membranes has been demonstrated without any change of the parenchyma being shown at post-mortem. Myerson also states that cases of primary tuberculosis of the bronchial mucous membrane may occur, or that tuberculosis of the bronchial mucous membrane can be demonstrated showing very little damage to the parenchyma. Vanduffel describes a case of primary tuberculosis of the mucous membrane and a case of bronchiectasis

with nearly enough identical roentgen pictures. He points out the value of bronchoscopy in distinguishing between these diseases. Berblinger has shown isolated tuberculosis in the main bronchi in 7 male and 7 female patients. Lemoine, too, describes several cases of primary bronchial tuberculosis.

Every case of circumscribed bronchitis is not tuberculous. Leegaard has described cases of circumscribed, non-tubercular, bronchitis which may also lead to stenosis of the bronchi.

According to Schubert, the symptoms of tuberculosis of the bronchial mucous membrane are in many cases so typical that it may already be suspected clinically of being present. He even considers the symptoms so typical that, for purposes of fixing a diagnosis of tuberculosis of the bronchial mucous membrane, it is as a rule not necessary to resort to bronchoscopy. The chief symptoms are unabated, cramp-like coughing irritation, asthmatic state or alternating dyspnoe, crepitation and whooping, sometimes even audible to those around the patient. Myerson also lays down the clinical symptoms of tuberculosis of the bronchial mucous membrane as being crepitation and wheezing, often audible to those around the patient and not infrequently interpreted as asthma.

Concerning symptoms, Berblinger points out that clinical symptoms depend on the form and extent of the tuberculosis in the bronchi. In the ulcerative form, there are quantities of bacilli. Sputum mixed with blood points to a disintegrating process. Cramp-like cough and hawkings belong to the regular symptoms. Stenoses are often interpreted as asthma over long periods.

Tuberculosis of the bronchial mucous membrane occurs in different forms. Dahlberg divides them into intramural, mural and extramural. Rischel describes bronchial tuberculosis as 1. miliary tubercles in the mucous or submucous membranes, 2. submucous infiltration, 3. ulcerative and 4. ulcerogranulomatose. Myerson points out that submucous infiltration is very common, and it may spread to a great extent and cause stenoses. Jenks classifies bronchial tuberculosis as 1. non-ulcerative, 2. hyperplastic, 3. ulcerative and 4. stenosis forming. Other authors vary in their division into types of tuberculosis of the bronchial mucous membranes. Thus Secrétan describes an insidious ulcerative form, a granulating ulcerative form, tuberculum in the bronchi and a

diffuse specific bronchitis. Berblinger gives the different forms of endobronchial tuberculosis as exudative—cheese like, ulcerous and productive with increased formation of connective tissue. This latter is of a sclerotic kind and at times gives rise to marked bronchial constrictions. Broadly speaking, these different divisions, with minor modifications, make up the majority of authors' conceptions of the various types. Kernan, has, for example, subserous, ulcerous and tumour-like granulation formations, as well as the glandular perforation. Lloyd and Budetti divide bronchogenous damage into:— I. Non-ulcerative a) acute tuberculous bronchitis, b) chronic tuberculous bronchitis: 1. Granulomatous variety. 2. Infiltrative variety and 3. Productive variety. II. Ulcerative lesions a) extrabronchial origin and b) intrabronchial origin. The acute type is seldom seen because at that stage there are not specially often indications for bronchoscopy. The chronic type, on the other hand, is common, and this depends on the fact, to a certain extent, that a steady stream of tubercular secretion passes the bronchi from the tubercular foci in the parenchyma. Chamberlain and Gordon classify bronchial tuberculosis into acute types which are later divided up into hyperplastic, ulcerative and ulcerohyperplastic, and chronic types which are divided up into insignificant, moderate and marked stenosis.

Steiner describes a form of bronchial tuberculosis in the main bronchi and their first branches which runs a characteristic course and which is primary to the bronchi. It progresses with slow destruction of the bronchial wall and produces a narrow, scarred stenosis. Bronchiectases arise afterwards behind this stenosis.

Schubert has shown that a predominant number of women have bronchial complications. From the collected statistics of 58 cases of bronchial tuberculosis, 49 cases were women and only 9 men. Berblinger has, however, found equal distribution among both sexes, a fact which does not agree with the usual view. Thus he found isolated tuberculosis of the main bronchi in 7 men and 7 women. Jenks finds bronchial tuberculosis commoner in women, and this may perhaps depend on the fact that they cannot cough up the secretion in the same effective way as men. There is therefore longer contact between the mucous membrane and the bacillus-carrying secretion. Lemoine shows a series of 10 men and 27 women.

Schubert states the localisation in the bronchi relating to endobronchial tuberculosis to be:— On the right side in 20 cases, on the left side in 22 cases, in the trachea in 2 cases. In one case bilateral in both the upper lobe bronchi. According to Lemoine, the localisation in a series investigated was:—

Trachea	5 cases
Trachea and main bronchi	4 cases
Right main bronchus	16 cases
Left main bronchus	7 cases
Right lower lobe bronchus	2 cases
Left » » »	3 cases

The treatment of tuberculosis of the bronchial mucous membrane has been given, on the whole, in the same way by various authors, namely cautery with nitrate of silver solution of varying strength, in the majority of cases about 30 %, cautery with lactic acid or by burning with a cauterizer. Rischel says that small wounds react well to diathermy, and that larger ones react best to cautery with silver nitrate solution. Dohlman obtained good results with silver nitrate cautery on ulcerations, and especially after the removal of membranes and granulations. Davison treated specific bronchitis with good results by galvano-cautery. Soulas used a treatment of silver nitrate and obtained a certain effect. Baron states that a combination of the bronchoscopic treatment with artificial pneumothorax or thoracoplasty gives good results. Frenchner treats with different corrosives or with cautery.

Kernan points out that even small, surface lesions should be treated. One does not know if it is a lesion developing or healing. He treats with nitrate of silver, generally 10 %, combined with cautery and the removal of granulation formations by means of forceps. In addition he has, in a number of cases, obtained good results from the use of a quartz lamp which he applied through the bronchoscope. It is known to produce good effects in the treatment of laryngeal tuberculosis and therefore should also have an effect on tuberculosis of the tracheal and bronchial mucous membranes. Attempts of this kind, however, have not been so comprehensive as to allow any conclusions to be drawn from

them. Kernan has observed that scar formations become soft by treatment with a galvanic current and has therefore as an experiment, transferred this treatment to scarred stenoses in the bronchi. He treated stenoses by placing the negative pole of a galvanic current in the scar. He does not mention the results.

The treatment must be repeated until healing takes place. Davies cauterizes, for example, every 14th day with 30 % silver nitrate solution.

Myerson is very restrictive with local treatment of tuberculosis of the bronchial mucous membrane. He considers local treatment rather ineffective, since the bronchial complication clears up when the pulmonary tuberculosis heals. However, cauterization of local granulations can provide increased air passage, and thus have a curative effect. He gives a warning against undue optimism to those who favour different kinds of local treatment, and urges them to bear in mind the frequency with which these affections often clear up. Myerson considers moreover that those lesions which do not heal spontaneously, do not heal with any sort of treatment either. Active lesions, i. e. lesions which have a tendency to increase in size, even become worse with local treatment. Inactive lesions may, however, sometimes be helped by cautery with weak silver nitrate solution, 5 % or at most 10 %. A stronger solution tends to produce necrosis. In the case of granulating processes, he considers that the use of active treatment should be very restricted, since with such treatment there is a great danger that the tuberculous process will spread. Hawkins Jr maintains that most patients are better for local treatment of bronchial tuberculosis than without such treatment. Chamberlain and Gordon do not hold much with local therapy in bronchial tuberculosis as causal therapy, but can in certain cases support other therapy. Sharp and Gorham point out that no sure method of treatment is laid down for tuberculosis of the bronchial mucous membrane. Jenks writes that treatment of bronchial complications in pulmonary tuberculosis has not advanced during recent years, and there is still no reliable method for the local treatment of these injuries.

The prognosis of bronchial tuberculosis is dependent on the parenchyma process (Myerson, Baron, Lloyd, Budetti and others). It is, however, always a serious complication to pul-

monary tuberculosis proper (Blanchy-Roux-Berger and Lemoine). Primary bronchial tuberculosis is, however, considered by Lemoine to be relatively favourable from a point of view of prognosis.

My own investigations.

A test excision has not been possible in all cases, partly because the symptoms have been so clear that a test excision was not considered necessary, and partly on account of a warning from the respective sanatorium doctors of the dangers of a test excision in bronchial tuberculosis (see test excisions below). The bronchoscopic findings which have been considered to justify fixing a diagnosis of tuberculosis of the bronchial mucous membrane have been:—

1. Miliary tubercles in the mucous or submucous.
2. Local submucous infiltration.
3. Punched out ulcerations.
4. Granulation formations.

The basic condition for the diagnosis has naturally been that the patient has pulmonary tuberculosis.

Concerning patients with negative sputum, a diagnosis of tuberculosis of the bronchial mucous membrane has never been fixed without a test excision.

The non-typical, above-described changes have been interpreted as suspected tuberculosis of the bronchial mucous membrane. Such changes in patients with pulmonary tuberculosis have been:—

1. Local bronchitic picture without granulations.
2. Oedematous changes round the cavernous bronchus.
3. Greater swellings in the bronchial mucous membrane without submucous infiltration.

A conspicuous, common symptom, which is present in tubercular bronchitis pictures, has been the swelling of the septum of the respective cavernous bronchi or of bronchi or branch bronchi with specific changes. In some cases test excisions have shown that it is not a specific bronchitis which produces these swellings, but an oedema of the mucous membrane. This has been considered to depend on altered circulatory circumstances at these points, and thus to be caused indirectly by a specific bronchitis.

In the whole material of 420 patients, tuberculosis of the bronchial mucous membrane has been observed in 71 cases (17%) and in 62 cases (15%) a suspected tuberculosis of the bronchial mucous membrane has been present, i. e. altogether 133 cases (31%). The material is to a certain degree selected material in such a way that in 279 cases the direct question has been whether a tuberculous affection of the bronchial mucous membrane was present. Thus, in 71 cases of the 279 (26%) under consideration a tuberculous affection was observed, and in 62 cases of 279 (22%) there was a suspected tuberculous affection, altogether 133 cases out of 279 (48%). In a number of cases the question could not be answered immediately, but a control bronchoscopic examination had to be made. In the same way, a number of cases occurred in which, at the first examination, no pathological signs could be

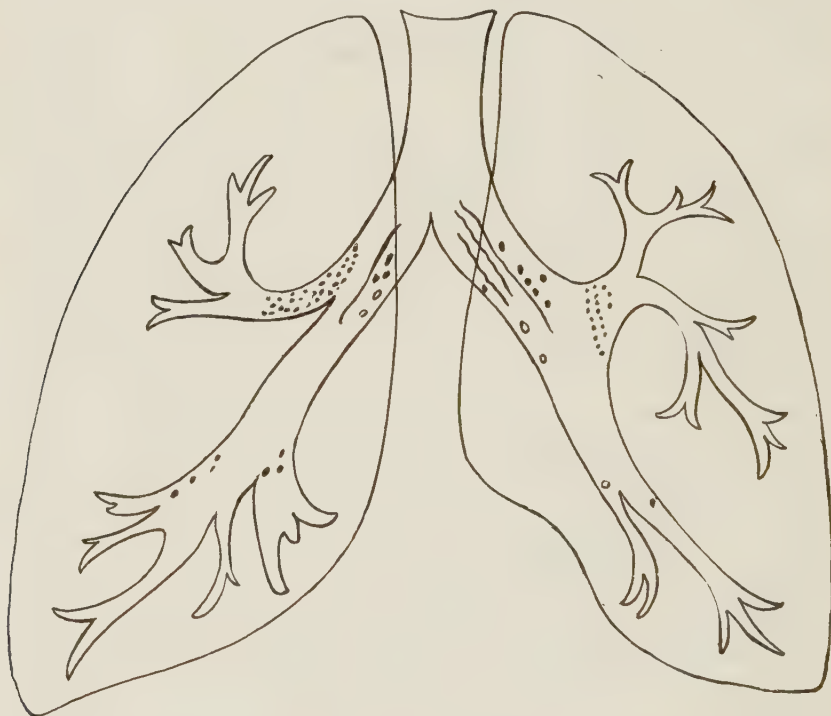


Fig. 1. Localization of tuberculosis of the mucous membranes of the bronchi. Lines mark wide spread localization, points less spread and circles lymphadenitis with perforation.

observed, but which later showed that tuberculosis of the bronchial mucous membrane was present.

Of the specific bronchitis cases, 5 were perforated lymphadenites (see above lymphadenites), one of them being a bilateral perforation. The localisation of the specific bronchitis changes was (see fig. 1).

	Right	Left
Main bronchus	6	12
Upper lobe bronchus	28	18
Middle lobe bronchus	3	
Lower lobe bronchus	4	2
Total	41	32

In two cases bilateral bronchial tuberculosis was found.

Of the specific affection material, 24 were men and 45 women, the bilateral cases being excluded.

The 62 cases of suspected tuberculosis of the bronchial mucous membrane are divided as follows (see fig. 2)

	Right	Left
Main bronchus	0	3
Upper lobe bronchus	24	27
Middle lobe bronchus	1	
Lower lobe bronchus	5	2
Total	30	32

At a later examination (2 years later), one of the cases showed itself to be a certain, specific bronchitis, 1 was bilateral and this was observed at a later bronchoscopic examination, and in one case it was a question of a lymphadenitis, while one case was a suspected lymphadenitis.

If then the 4 cases are excluded, the division is 24 men and 34 women.

In 52 cases, bronchitic pictures were observed which could not be classified as even suspected specific bronchitis. They were given the name of non-specific bronchial affections. Of these 52 cases, 30 were diffuse and of quite ordinary appearance, while 22 were localized in a certain bronchus or in a small region of the bronchial tree. The latter are especially interesting as they

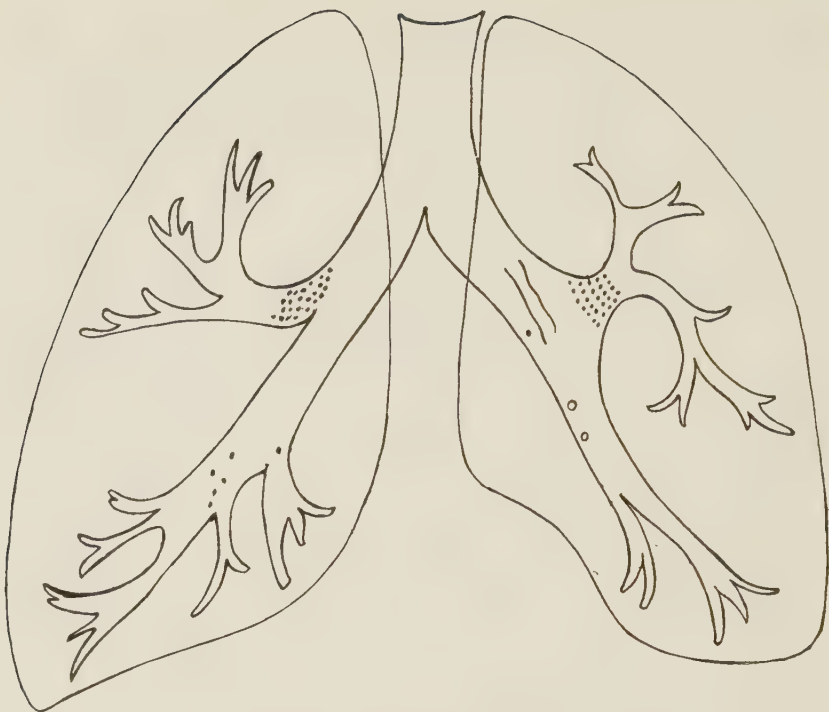


Fig. 2. Localization of suspected tubercular changes. Lines mark wide spread localization, points less spread and circles nonperforated lymphadenitis.

of course may be specific, but are entirely lacking in the ordinary or suspected signs of specific tuberculosis of the bronchial mucous membrane. They are even more interesting when they are localized at a cavernous bronchus. A stream of secretion from a cavernous bronchus always produces a concentrated irritation of the mucous membrane just at the opening of the bronchus. It is, however, not absolutely necessary that the bronchitic changes observed should be specific. In a number of cases, test excisions have also been made and they have been negative for tuberculosis. Since it has been necessary, as was mentioned above, to observe a certain restraint with regard to test excisions, full certainty has not been reached in all cases. The diffuse bronchitic pictures were in 2 cases combined with bronchostenosis, while the localized cases were combined with such a stenosis in 5 cases. This finding gives rise to the suspicion that there may have previously been a specific

change which healed with stenosis, but with a non-specific change persisting. In one case of these stenoses, a test excision was carried out but gave negative results.

In 4 cases, stenosis in the bronchial tree, free from irritation, was observed; even in relation to these cases there was a well-founded suspicion that it might be a question of a healed tuberculosis of the bronchial mucous membrane with persisting, irritation-free stenosis.

In 88 cases the bronchoscope findings were quite negative. In one of these cases, however, there was observed later a tuberculosis of the bronchial mucous membrane with stenosis, and in another case a suspected specific change in the bronchus.

Because of the successful attempts in recent years to treat tuberculosis with, *inter alia*, streptomycin and PAS, the local treatment of bronchial complications in pulmonary tuberculosis has been more and more put in the background. The treatment itself with these means has nothing to do with bronchoscopy, but the progressive control of the treatment must be carried out bronchoscopically. In a number of cases, however, local treatment has shown itself to produce a contributory effect, especially in cases of heavy infiltration of the bronchial mucous membrane. With regard to control bronchoscopy, we refer to the section "other bronchoscopic examinations in pulmonary tuberculosis." Local treatments have, however, a certain importance for the understanding of the section below which deals with occlusion treatment, and will therefore be quite summarily gone through. It has not at any rate been possible to separate clearly the cases which were treated with nitrate of silver from those which were only treated with galvanocautery. In a number of cases the treatment has also been continued with PAS or streptomycin. The tabulation must therefore be looked at with this circumstance clearly before the eyes. See table 1.

From the table may be seen the fact that stenosis formation is less common in the miliary and submucous infiltration forms of tuberculosis of the bronchial mucous membrane than in the ulcerous and granulating forms. The latter form of tuberculosis of the bronchial mucous membrane healed in 14 out of 26 cases with stenosis, and in 6 cases of unhealed changes of the bronchus

Type.	Treatment	Healed	Ditto with stenosis	Not healed	Ditto with stenosis	Total
Miliary tubercles and submucous infiltration	Silver Nit	7	3	4	4	18
	Silver Nit + caustic	1	—	—	1	2
	Caustic	—	4	—	3	7
	None	—	—	1	—	1
Ulcerous	Silver Nit	6	8	1	4	19
	Silver Nit + caustic	—	1	1	—	2
	Caustic	—	—	—	—	0
	None	—	—	—	2	2
Granulating	Silver Nit	2	10	—	2	14
	Silver Nit + caustic	—	2	1	1	4
	Caustic	—	2	—	—	2
	None	—	—	—	—	0
Total		16	30	8	17	71

Table 1. Treatment of specific bronchitis.

produced stenosis in 5 cases. The ulcerative form healed with stenosis formation in 9 cases out of 15, and produced stenosis formations in 4 out of 6 cases of unhealed bronchial affection. In this form, which has been designated as a miliary form and submucous infiltration, only 7 cases out of 15 showed stenosis, and among the unhealed cases there were 8 out of 13. Among these unhealed cases, then, the last-named form shows as high a stenosis frequency as the ulcerative form; this to a certain degree depends on the fact that a hypertrophy of the mucous membrane itself is present, which in its turn causes a constriction of the bronchial lumen.

In the total number of cases of bronchial tuberculosis which were treated with some form of caustic, stenosis formations were produced except in one single case, which was treated with silver nitrate combined with caustic. The number treated with caustic is, however, too small to allow of accurate conclusions.

The treatment of the cases of suspected specific bronchitis is likewise not entirely uniform, since among them are cases which

Treatment	Healed	Ditto with stenosis	Not healed	Ditto with stenosis	Total
Caustic	—	—	—	1	1
Ditto, occlusion requested	—	1	4	1	6
Later specific bronchitis not treated	—	—	—	1	1
Silver nitrate, controlled	14	8	6	1	29
Silver nitrate, not controlled	—	—	9	—	9
Silver nitrate + caustic	—	3	1	—	4
No treatment, controlled	2	—	2	—	4
Ditto, not controlled	—	—	6	2	8
Total	16	12	28	6	62

Table 2. Treatment of suspected specific bronchitis.

were treated by an attempt at occlusion. See table 2. Unfortunately amongst these cases are a number which were not bronchoscopically controlled.

In examining the table of the treatment of suspected specific bronchial affections, it will also be seen that the total number of healed cases (14) without stenosis are cases treated with silver nitrate, while the total number treated with caustic (4) all led to stenosis of the bronchus. In addition, 8 cases of bronchitis treated with silver nitrate healed with stenosis of the bronchus, 2 untreated cases, bronchoscopically controlled, healed without stenosis and 2 other untreated cases did not heal, but these, too, were shown to be without stenosis on bronchoscopic control.

A number of those cases classified as not healed are such that treatment was broken off on account of deteriorated general condition or of a change in position with regard to treatment.

A comprehensive examination of both these groups, the specific and the suspected specific cases of bronchitis, showed that the ulcerogranulomatous form of bronchial tuberculosis is the most

malignant with regard to stenosis formation. The healing tendency is broadly the same in all the cases, although unfortunately control bronchoscopy of the miliary and submucous infiltrative forms has not been carried out to the desired extent. The whole number of healed cases of tuberculosis of the bronchial mucous membranes is 46 out of 71. The question may naturally be raised as to whether the treatment was the principal cause of healing or whether improved general condition or some other cause was the real reason why healing set in. It has been by no means a question in all cases of improved general condition, but it happened in as many as 4 cases that the tuberculosis of the bronchial mucous membrane healed while the lung process progressed in such a way that the patients died respectively 5, 6, 8 and 30 months after the conclusion of the treatment. These cases to a certain degree support the contention that the treatment had an effect on the tuberculous processes in the bronchi.

Of the total cases of tuberculosis of the bronchial mucous membrane, 47 out of 71 (67%) produced bronchostenoses whether the tuberculous process healed or whether it was still in progress on control bronchoscopy.

In the whole of the combined material, only in two cases has it occurred that tuberculosis of the bronchial mucous membrane was shown on test excision without any changes of the parenchyma being observed at the clinical or roentgenological examination of the lungs. (Cases 208 and 413). Both of these cases proceeded to stenosis of the bronchus and later clear changes of the parenchyma also supervened. In other cases changes of the parenchyma have also been absent, but in these cases it was a question of lymphadenitis which perforated into the bronchial tree (See section lymphadenitis).

The unspecific bronchial changes were to a far less extent the object of endobronchial treatment. The diffuse bronchial changes have not in any single case been treated in this way, while isolated cases of localised non-specific bronchial changes have been treated with silver nitrate solution. These cases which were treated are, however, so very small in number, that they do not give any picture of the real results of treatment of these forms of bronchitis. From another point of view they are nevertheless interesting, on account of stenosis formation. See table 3.

	Healed	Ditto with sten- osis	Not healed	Ditto with sten- osis	Total
Diffuse, con- trolled	—	—	9	—	9
Not ditto	—	—	16	1	17
Localised, controlled	3	2	5	1	11
Not ditto	—	—	14	1	15
Total	3	2	44	3	52

Table 3. Survey of the non-specific cases of bronchitis.

On examining this table, there will be found 2 cases of stenosis of the bronchus in the groups of uncontrolled cases. The stenosis was naturally found in these cases at the first (and only) bronchoscopic examination. The other 3 bronchostenoses occurred, as will be seen from the table, only in cases of localised bronchitis. With reference to this, it must be further observed that they may be or have been of specific character, but the specific infection had healed.

Discussion: It has already previously been pointed out that there are great difficulties in attempting to compare the different statistics concerning the incidence of tuberculosis of the bronchial mucous membranes. The material is much too heterogeneous, and methods of investigation make it impossible to compare all the data. The most certain method must be post-mortem material. But even this varies within wide limits. When Schubert writes that the symptoms of tuberculosis of the bronchial mucous membrane are so clear that it is possible to diagnose this complication without bronchoscopy, one must remain doubtful. McIndoe and others have, in fact, carried out a comprehensive routine examination without selection of patients, only with demonstrated pulmonary tuberculosis and have come to the conclusion that only 1/3 of the cases with clinically suspected or demonstrated tuberculosis of the bronchial mucous membrane had a tuberculosis of the bronchial mucous membrane which was bronchoscopically demonstrable. This is naturally not absolute proof that the remaining 2/3 did not have tuberculosis of the bronchial mucous membrane, but in

every case they did not have it in the larger bronchi. In our material also, in 71 cases out of 279 of clinically suspected tuberculosis of the bronchial mucous membrane, it could be observed (26 %). In addition, there are comprised in this material 62 cases of bronchoscopically suspected tuberculosis of the bronchial mucous membrane (22 %) which added to the previous figure gives 48 %.

With regard to the frequency of tuberculosis of the bronchial mucous membrane, McIndoe and others, on a material of routine bronchoscopy, give 11 % certainly demonstrated tuberculosis of the bronchial mucous membrane and 4.5 % suspected tuberculous changes. The material which is most nearly comparable with that before us is that described by Hawkins Jr.: That, too, is a selected material, examined bronchoscopically on account of suspicions of tuberculosis of the bronchial mucous membrane. As is clear from the above, the diagnosis was fixed bronchoscopically. He arrives at the figure 25.6 %. This figure agrees very well with our own; of 279 cases of clinically suspected tuberculosis of the bronchi, the diagnosis could be confirmed bronchoscopically in 71 cases (26 %).

Schubert showed that a preponderating number of women were attacked by tuberculosis of the bronchial mucous membrane, while Berblinger was unable to show any difference in the division of this complication between the two sexes. In our material the division is 24 men and 45 women. This shows a real preponderance in the women even if one takes into account the fact that more women than men were received at the sanatorium, and that more women than men were bronchoscopically examined. The same proportion is present also in cases of suspected tuberculosis of the bronchial mucous membrane.

The symptomatology of tuberculosis of the bronchial mucous membrane is given, on the whole, in a similar manner regarding the bronchoscopic finding. It has been considered quite generally that the miliary tubercles and the submucous infiltration are typical tuberculous manifestations like the punched out ulcerations and the granulation formations with eventual histological diagnosis in doubtful cases. A number of authors have even included the irritation-free stenoses as tuberculosis of the bronchial

mucous membrane. In the majority of cases this has probably been so, on condition that an open pulmonary tuberculosis or possibly a perforating adenitis has been present. In our material, however, these cases are not diagnosed as tuberculosis, but instead as a possibly healed tuberculosis. In one case a test excision was made of such a stenosis in a case of healed pulmonary tuberculosis. This showed itself to be negative as far as tuberculosis was concerned.

A further difficulty was to get a clear picture of the results of local treatment. Authors have said that they have had success with this or that method of treatment of bronchial tuberculosis, but have given no figures which might throw a light on this circumstance. With existing new means, this treatment with silver nitrate, lactic acid, caustic, arc lamps etc: has lost some of its importance. Nor have most authors so large a material to set out as to establish any proof of the superiority of one method over another. Our own material has not given sure proof either of the palpable effect of the means tried. Nevertheless there appears to be a certain contributory importance in the effect which both the silver nitrate treatment and galvano-cautery has had. Myerson showed cases which became worse under treatment with silver nitrate solution, especially in extensive tuberculosis of the bronchial mucous membrane. In a number of our cases, too, a deterioration set in, but whether this was dependent on the treatment with silver nitrate or on a general deterioration of the tubercular infection could not be decided with certainty.

The final result of a bronchial tuberculosis which healed, and which also in a number of cases did not heal, has in many cases been bronchostenosis. Specially malignant with regard to the formation of stenosis are the ulcerative and granulating forms of bronchial tuberculosis. Concerning these complications reference is made to the section dealing with bronchostenoses.

c. Bronchostenoses.

Together with tuberculosis of the bronchial mucous membrane, bronchostenosis has been the complication to the pulmonary tuberculosis proper which has come most to the fore in studies since bronchoscopy began to come into use more generally in pulmonary tuberculosis. Already the clinical symptoms often

draw the attention to the presence of a bronchostenosis. Thus Dahlstedt remarks that a pronounced stenosis in the greater bronchi shows quite a characteristic picture. The anamnestic information already gives information on "creaking, buzzing, grating or wheezing which may cause considerable inconvenience to the patient" (quoted from Jackson). These patients often go under the diagnosis of asthma. These signs of bronchitis (asthmatoïd wheeze) can often be observed physically at long range, they can even be localized in lung and lobe. The physical symptoms may vary from day to day and sometimes before and after coughing. In isolated cases a wheezing stenosis noise has developed. In fluoroscopy a clouding of the mediastinum is often observed. The stenosis can only be localised in isolated cases by means of roentgen photography without a contrast medium. The more precise diagnosis of the position and aspect of the stenosis is conveniently made by means of bronchography and bronchoscopy.

With regard to stenoses, Chamberlain states that endobronchial tuberculosis is really a problem of mechanical obstruction which produces such complications as obstructive emphysema, bronchiectasis and atelectasis. It thereby complicates the pulmonary tuberculosis. In the acute phase, bronchial tuberculosis impairs the drainage because the peristaltic movement is reduced, the ciliary action is lost and the lumen is constricted by a tissue of granulations and a cheese-like exudate. In the chronic phase, there are two kinds of obstruction. On the one hand there is a softening of the cartilage, dependent on destruction, which results in increased motility of the bronchial wall, so that inspiration permits a normal stream of air, while expiration hinders the passage of air because the soft bronchial wall is pressed together and locally occludes the lumen of the bronchus. It then becomes an emphysema. The other type of obstruction arises in unelastic stenoses of the scarred type. The treatment depends very much on which of these changes is present in each respective case.

On collected material from the sanatorium in Österåsen, Sandler says that the number of bronchostenoses among the whole material was 2% in the cases of confirmed stenoses. He states, however, that the stenosis percentage is probably higher. Bronchography can throw light on possible stenoses in the bronchial tree which cannot be reached by the bronchoscope. If, however, it is a

question of deciding what kind of stenosis it is, or whether a test excision is to be made, this must be done with the bronchoscope. These specific changes are often the cause of unsuccessful collapse treatment.

Myerson maintains that even the submucous tuberculous bronchial changes can produce extensive stenosis. A relative stenosis may rapidly become complete through the fixing of cheese-like masses in the stenosis. Pressure from adenites produce only about 1 % stenoses in adult patients. However, in isolated cases, pressure necrosis may set in and damage the bronchial cartilage so that a collapse of the bronchus takes place.

Comprehensive studies of the tuberculous bronchostenoses have been made by Rafferty and Shields. Of the cases of bronchial tuberculosis studied, fatalities in a series of 40 were 42.5 % for the whole material. The cases of bronchial tuberculosis with stenosis numbered 13, of which 7 were dead (54 %); of the cases with extensive tuberculosis of the bronchial mucous membrane, 12 cases, 6 were dead (50 %). Of the cases with insignificant or moderate ulceration, 4 out of 13 were dead (27 %).

Stenoses may be caused by endobronchial processes or by pressure from without (lymphadenitis), maintain Tuttle, O'Brien, Day and Philips. The endobronchial processes depend on a granulating-ulcerous process or a fibrous stenosis. The former were treated with 30 % solution of silver nitrate, and healed in 70 % cases. 11.9 % improved, while 16.4 % deteriorated so that treatment was broken off. The result of this ulcerous stenosis process was, according to this investigation:

Arrested	18	26.0 %
Apparently arrested	4	5.7 %
Quiescent	4	5.7 %
Unstable	20	28.9 %
Dead	23	33.7 %

The authors maintain, as a result of the investigation, that an ulcero-stenotic process of a tuberculous kind is a very dangerous complication. The outcome of the cases with fibrostenosis was:

Arrested	5	21.7 %
Apparently arrested	1	5.3 %
Quiescent	3	13.0 %
Unstable	7	30.0 %
Dead	7	30.0 %

They maintain further that it is possible that spontaneous healing of the ulcerostenotic processes in the bronchi set in, but it is most probable that these too heal with stenoses, especially if the processes are of circular extension.

Steiner has described apparent primary tuberculosis of the bronchial mucous membrane which produced stenosis in the main bronchi. Catala has likewise described cases of primary bronchial tuberculosis with stenosis. Bernou maintains that stenoses in the cavernous bronchi may produce pressure cavities. Coryllos points out the great importance of cavernous bronchi in the healing of cavities. It may be quite intact or only very slightly affected with stenosis, so that it leaves an air passage in both directions. It may, however, be so heavily affected with stenosis as to allow a passage in only one direction, i. e. an air stream into the cavity (this will be dealt with later in connection with pressure cavities) or it may be so heavily affected that no air passes at all in either direction (see occlusion).

It has been possible to demonstrate stenoses roentgenologically by an emphysema peripheral to the stenosis. Crafoord maintains also that these emphysemas with subsequent bronchiectases are the cause of difficulties in healing in a number of thoracoplasty operations, which, in spite of good collapse, do not heal. It is therefore quite natural that when bronchiectases are present in specific lung processes, there is difficulty in obtaining bacillusfree sputum after the operation. Steiner also maintains the unfavourable healing conditions which arise in a bronchiectasis formation behind a stenosis.

Lloyd and Budetti have treated stenoses by dilations, but have never seen a stenosis definitely recede because of these dilations. On the other hand, after these dilations, there have arisen pains, hemoptyses and recurring bacilli, and ulcerations have followed instrumental stretching of stenoses in a healed scar. Sharp and Gorham give a warning against treatment by dilation.

Cohen and Wessler, too, discourage dilation of bronchostenoses. Kernan treated stenoses with a galvanic current, but does not mention the results. He points out, however, that no result is obtained by means of dilations. Myerson maintains that stenoses are so extensive that there is no possibility of improving them by soundings.

My own investigations.

147 cases, comprising 33% of the whole material examined, were sent for examination for suspected stenosis. Stenosis was shown in 79 cases (19% of the whole material) and in 68 cases the result of the examination with regard to stenosis was negative. In these negative findings, however, there are included a number of routine examinations before the carrying out of a pneumothorax. The positive findings had the following clinical diagnosis or indication for bronchoscopy:

Atelectasis	24 cases
Clinical signs of stenosis	14 »
Tuberculosis of the bronchial mucous membrane	7 »
Atelectasis after pneumothorax	2 »
Tumour atelectasis	2 »
Perforating adenitis	1 »
Lymphadenitis	2 »
Non-specific bronchitis	1 »
Pressure cavity	2 »
Result of occlusion treatment	2 »
Asthmatic trouble	2 »
Quick healing of the cavity	1 »
Atelectasis after silver nitrate cautery	1 »
Ineffective pneumothorax	1 »
Not free from bacilli in spite of pneumothorax	6 »
Open cavity in spite of pneumothorax	3 »
Not healed after thoracoplasty	2 »
Pneumothorax in view	3 »
Thoracoplasty in view	2 »
Pulmectomy in view	1 »

The negative bronchoscopic findings had the following diagnosis or indication for bronchoscopy:

Atelectasis	28 cases
Clinical signs of stenosis	8 »
Atelectasis after hemopthysis	1 »
Lymphadenitis	1 »
Parenchyma infiltrate of unknown kind	1 »
Bronchial fistula to the pleura	1 »
Pressure cavity	1 »
Atelectasis after pneumothorax	1 »
Asthmatic trouble	3 »
Not filled out at bronchography	2 »
Bronchiectasis	2 »
The lung does not go out after pneumothorax	1 »
Pneumothorax in view	13 »
Thoracoplasty in view	2 »
Lobectomy in view	1 »
Monaldi drainage in view	2 »

The fact which is striking at a survey of both these tables is that in the examination of suspected stenosis in 52 cases of atelectasis, stenosis was only found in 24 cases. The explanation as should be clear later from the account of atelectases, lies in the fact that a number of the cases of atelectasis were of rather circumscribed extension, and in these cases the bronchostenosis may naturally lie so far towards the edge that it cannot be detected by the bronchoscope. A large extension of atelectasis gives in any case a larger number of positive bronchoscopic findings than a less extended one. In 8 cases of clinical signs of stenosis the bronchoscopic findings were negative. Dahlstedt has stated that the clinical findings in stenosis of the greater air passages are characteristic and easily recognised. On the clinical findings in stenosis in the finer air passages he says nothing. One can see from this finding that the clinical signs of stenosis are by no means quite such certain signs. With regard to asthmatic troubles, in 5 cases examination was made for suspicions of stenosis. In 2 of these also stenosis was found. For the other findings, reports will be found in the respective sections on treatment of the different details.

In 4 cases dilation of the bronchostenosis was undertaken. A short report of these cases is of interest.

Case 11. Female, 8 years. In November 1946 atelectasis in the left lower lobe and later a cavity with fluid level. No effect with penicillin or sulpha preparations. Oxygen bound staves shown in the ventricle rinsing fluid. Question: Stenosis? *Bronchoscopy* (Feb: 1947): A granulation plug just against the opening of the upper lobe. Perforating adenitis. Test excision of the plug. = Tbc. Secretion test: Tbc negative right, positive left in direct preparation. On culture, also positive right. Human type. Phrenicus obstruction and 3 months later control bronchoscopy because of increased atelectasis. The new bronchoscopic examination showed less irritation but incipient stenosis. 1 month later roentgen examination showed regression. Tbb O. Dilation of the bronchostenosis recommended. New bronchoscopy carried out and this showed stenosis of the main bronchus without specific signs present. Dilation was carried to no. 14 (Jackson sounds). The atelectasis was resolved and no secondary effects arose after the treatment. Control bronchoscopy was not carried out.

Case 37. Woman, 31 years. Pulmonary tuberculosis 1942. Left-sided affection. Since 1943 bronchitis and positive tbb sputum. No cavity shown. Question: Specific bronchitis? *Bronchoscopy* Feb: 1944: Ulcerative tubercular bronchitis in the left main bronchus. In the course of 3 years, 15 treatments with silver nitrate and healing with bronchostenosis in the main bronchus which occasionally produced stagnation of the secretion and must be aspirated after sounding and dilation. 1947 thoracoplasty. Control bronchoscopy in Jan: 1948 showed irritation-free stenosis of the main bronchus.

Case 112. Woman, 36 years. Pulmonary tuberculosis since 1938. Examined bronchoscopically 1942 at the Karolinska Hospital. Perforating adenitis shown. Later, fresh signs of bronchitis and an atelectasis in the left lung. Question: Specific bronchitis? *Bronchoscopy* June 1944: Diffuse bilateral bronchitis and specific bronchitis in the left lower lobe bronchus (perforating adenitis?). Treated with silver nitrate. Repeated 2 months later. Had had fever as a result of treatment. Tbb positive. New treatment recommended. Several treatments given later. Parenchyma changes supervened. A very heavily pronounced bronchostenosis in the main bronchus developed. An atelectasis occurred and repeatedly there was stagnation of the secretion which was treated by aspiration through the bronchoscope. The pulmonary tuberculosis developed more and more. The general condition deteriorated. Several attempts were made at dilating the stenosis without being able to influence it to the smallest degree. A short time after the treatment the patient was a little less inconvenienced, but later returned to the same condition as before the treatment.

Case 413. Woman, 39 years. Old pulmonary tuberculosis since 1933. Tbb +. Symptoms of bronchitis since 1945. No changes in the lung parenchyma to explain the clinical finding. Question: Tuberculous bronchitis? *Bronchoscopy* May 1946: Specific bronchitis in the left upper lobe. Test excision: Tuberculosis. Changes of an ulcerogranulomatous kind. Thoracoplasty performed. The changes progressed rapidly. After thoracoplasty an extensive atelectasis appeared with more difficult voiding of the secretion. Aspiration and dilations performed several times, as well as galvanocautery of a polypous formation in the bronchial focus itself. The stenosis only increased, and the treatments gave only temporary relief. The stenosis was unaffected. However, no secondary effects arose.

Discussion: The investigation has shown that in a great number of cases a bronchostenosis appears after the endobronchial tuberculosis. There has been discussion as to the mechanism itself in the appearance of stenoses. Myerson maintains that it is not only the ulcerogranulomatous changes of the bronchi which

produce stenosis, but also the submucous. It is probably possible that a stenosis arises partly through a constriction on account of the direct constriction of the bronchus by the submucous infiltration, and partly on account of necrosis of the cartilage and scarred collapse of the bronchial lumen. In fact, in our material, stenoses have appeared both in the ulcerogranulomatous and in the other forms of tuberculosis of the bronchial mucous membrane.

Myerson has stated that pressure from a lymphadenitis has only been the cause of 1 % of all the cases of tuberculous bronchostenosis. Such cause of bronchostenosis, provided the adenitis has not perforated, has been observed with certainty in 2 cases in our material. The stenosis has then arisen from quite another cause which has been dealt with in connection with lymphadenites.

The stenoses have in several cases produced atelectases and stagnation of the secretion. Crafoord has also given as a cause of difficulties in healing in a number of thoracoplasties precisely the emphysema and bronchiectasis which appear behind a stenosis. This may also be true to a corresponding degree of pneumothorax, in spite of the fact that in these cases another factor is added. In our material there were also 9 unhealed cases with stenosis on which pneumothorax was performed, and a bronchostenosis was observed in 2 cases of unhealed thoracoplasty.

Sandler gives 2 % bronchostenoses for the whole material at Österåsen sanatorium, but points out at the same time that the figure should probably be higher. On the whole of our material, which is to a certain degree selected on account of bronchial complications, bronchostenosis was shown in 19 %, a rather high figure.

With regard to treatment by sounding, most authors are very pessimistic. Lloyd and Budetti have never seen a stenosis recede by soundings and dilations. Others (Sharp and Gorham) give a direct warning against treatment by sounding. Kernan, too, gives a warning against dilations, but instead resorted to the galvanic current. Our own treatments have not been encouraging either. In one case of bronchostenosis with atelectasis, the atelectasis receded, but we know nothing about the bronchostenosis since control bronchoscopy was not carried out. In the other cases, dilation had no success. In one case it produced a

febrile condition of long duration and a deterioration of the general condition. Aspiration of stagnant secretion has, however, in a number of cases afforded temporary relief.

d. Valve mechanism.

By the valve mechanism is meant an unilateral air stream, and in ordinary words such a stream directed inwards to a certain part of the lung, most often a cavity, without production of an air stream in the opposite direction. This mechanism, as its name implies, consists of a certain valve mechanism in the bronchus, eventually a cavernous bronchus, which feeds the region in question.

As was said above in describing stenoses, there are different forms of these. With a certain degree of stenosis, the air can pass in and out unhindered, with a more pronounced stenosis the air can only pass in and not out, and with a further degree of stenosis the air can pass neither in nor out. With the intermediate type of these stenoses, the so-called one-way mechanism or valve mechanism, the above described situation is brought about. An inflation of the lung tissue is caused. If it is a matter of a cavity, a pressure cavity is produced, and the risk arises of bursting of the lung tissue or rupture of the cavity. According to Kajser and Huizinga the valve comes into being in the following way: on inspiration, the lung stretches itself out and passes the air through a partial stenosis, but on compression of the lung in expiration, a swelling of the mucous membrane occurs and this may produce total stenosis in a relative stenosis. The danger of this complication arising is especially great when the stenosis is caused by a swelling of the mucous membrane. If the stenosis is caused by granulations, these may be removed by an instrument and the passage thereby be restored thus causing the valve mechanism to cease. The swelling of the mucous membrane itself remains, however. Myerson considers that a bronchial stenosis with a diameter of 2 mm. is sufficient to give an entire lung a supply of air.

Bernou states that stenoses and specific processes in the bronchi may give rise to pressure cavities through viscous secretion, fibrine clots or oedema arising in the stenosis itself, which on this account becomes so large that a valve mechanism is set up. By treatment of these complications the valve mechanism may

be removed. Alexander states that the danger of rupture of the cavity is present when a pneumothorax is carried out on a lung with valve mechanism. It is then that the risk of rupture seriously occurs. Valve cavities may then be present already before the carrying out of the pneumothorax. It is even possible that a pneumothorax valve may arise through bursting of the lung tissue itself. Dahlstedt points out that it is not only a cavity, but also a lobe or even a whole lung which may become inflated through the valve mechanism of a bronchostenosis. Coryllos sets forth the great importance of the cavernous bronchus. The so-called one-way mechanism is dangerous, since, in expanding, the lung allows air to pass in, but on compression of the lung, the stenosis becomes total.

Lemoine has treated 6 cases of pressure cavity with bronchogenous aspiration, of which 5 healed without adhesions and a collapsed lung.

My own investigations.

Fifteen cases of suspected valve mechanism were sent for examination. In 6 of the cases, such a valve mechanism could be demonstrated, while in the remaining 9 cases, no cause for the valve mechanism could be found bronchoscopically.

The positive cases were:

Case 13. Man, 23 years. Tuberculosis — adenitis 1944. Roentgen examination of the lung in June 1944 showed pulmonary tuberculosis. Tbb +. Right pneumothorax gave a good collapse but the cavity did not close up. Question: Valve mechanism? Stenosis. *Bronchoscopic examination* December 1944: Rigid walls in the right upper lobe with probable valve mechanism. Galvano-cautery was performed at this opening on request and was repeated 4 times during 1½ years. After the first treatment there was fever and atelectasis in the right upper lobe. The opening in the bronchus was constricted and the cavity healed.

Case 24. Woman, 22 years. Primary pulmonary tuberculosis 1940. Bilateral pleurisy 1941 and bilateral parenchyma changes 1945 with right side pointed cavity. Cavity of the pressure type. Aspiration treatment recommended. Question: Valve mechanism? Bronchoscopy could not be carried out on this occasion because the patient had high fever. Obstruction of the phrenicus was performed. Instead, patient was bronchoscopically examined later (April 1946): Thick mucous membrane near the opening of the upper lobe on the right side with heavy constriction of same. On request, galvano-cautery was performed for occlusion treatment. On the grounds that the conditions of the patient became worse and worse, the endobronchial treatment was not continued.

Case 80. Man, 39 years. Old tuberculosis of the lung with pointed cavity on the right side. Obstruction of the phrenicus 1/2/46. Question: Valve mechanism caused by tuberculosis of the bronchial mucous membranes? *Broncho-*

scopy carried out February 1946. Laryngeal tuberculosis and tuberculosis of the right upper lobe with stenosis. Silver nitrate treatment. 2 months later: Tbb +. Cavity increased. Valve mechanism? Fresh bronchoscopy: Heavy stenosis of the right upper lobe. Valve mechanism. Thick secretion, which was difficult to get up. Aspiration. Silver nitrate treatment. 1 month later: Cavity diminished. The bronchus seems to be choked lately. New bronchoscopy showed heavy stenosis, reddened opening of the bronchus, bronchitis present. Aspiration. Silver nitrate treatment. Death $\frac{1}{2}$ year later.

Case 150. Man. 37 years. Right-sided liquid affection of the upper lobe 1936. Right pneumothorax 1936—1942. Cured. In December 1945 cough and lassitude. In January 1946 a cavity was observed in the right middle lobe (top of the lower lobe?). Phrenicus exheres performed and the cavity increased. Question: Valve mechanism? Occlusion treatment. *Bronchoscopy* April 1946: Suspected specific bronchitis in and round the opening of the right middle lobe. Caution for occlusion performed. Constriction of the lumen not very pronounced, but valve mechanism possible. A further cautery was performed on the opening of the middle lobe and this was already after the first treatment again surrounded with granulations. Because of the deteriorating general condition of the patient, the treatment was not continued. Death 1 year later.

Case 116. Man. 51 years. Old pulmonary tuberculosis with right sided atelectasis of the upper lobe and with a large cavity. In the left lung dispersed centres. Question: Stenosis? Tuberculosis of the bronchial mucous membrane? Aspiration recommended. Valve mechanism? *Bronchoscopy* 1947: Suspected specific changes in the right upper lobe with stenosis. Probably valve mechanism. A certain difficulty in the voiding of the secretion. Galvano-cautery was practised by request. 1 year later: troublesome bronchitis symptoms. Hoarseness. Control bronchoscopy recommended. The examination showed laryngeal tuberculosis and bronchial tuberculosis of the right upper lobe. New cautery treatment was carried out. The treatment was broken off.

Case 259. Woman. 24 years. Left-sided pulmonary tuberculosis 1942. Left pneumothorax same year. Spring 1945 in progression with large bilateral cavities. Left pneumothorax could not be repeated. Right pneumothorax in May 1945. Good lung collapse, but in spite of this a huge cavity at the top of the right lower lobe. Question: Valve mechanism? Aspiration treatment recommended. Treatment of possible specific bronchial affection? *Bronchoscopy* June 1945: 1st: dorsal branch bronchus in the right lower lobe a cavernous bronchus. Right bronchial tuberculosis with incipient stenosis formation in lower lobe bronchus. Aspiration. Silver nitrate treatment. Valve mechanism. The bronchial changes increased, the stenosis progressed further to the main bronchus, and finally it was impossible to reach the cavernous bronchus. The cavity increased at the beginning but diminished somewhat later. The treatment was broken off as being ineffective.

The negative cases were:

Case 41. Man. 24 years. Pulmonary tuberculosis with left pointed cavity observed in January 1946. Pneumothorax 6/2/46. The cavity did not collapse. Tbb +. Question: Valve mechanism? Aspiration recommended. *Bronchoscopy* in April 1946: Negative finding. Aspiration carried out in the 1st: dorsal branch bronchus of the left upper lobe bronchus. After a month the cavity had diminished and aspiration was again performed. Control bronchoscopy $\frac{1}{2}$ year later gave negative results. Direct secretion test and guinea-pig test were bilaterally negative for tuberculosis.

Case 63. Man. 39 years. Pulmonary tuberculosis with pressure cavity on the right side. Question: Valve mechanism? *Bronchoscopy* 1946: Mild signs of bronchitis on the right side not of specific type. No valve mechanism. 2 months later: Squeaking and buzzing in the chest. Tbb +. Specific bronchitis? Bronchoscopic examination gave negative finding. Repeated after $1\frac{1}{2}$ years with huge cavity in the top of the right lower lobe. Aspiration of the cavity

recommended. At the examination it was observed that nearly all the secretion came from the first dorsal branch bronchus in the right lower lobe bronchus, but otherwise the findings were negative. Aspiration carried out. Treatment broken off afterwards.

Case 237. Man, 28 years. Cavernous pointed process on the right side with pneumothorax. After cautery good collapse. The cavity did not, however, collapse. Question: Valve mechanism? *Bronchoscopy 1946:* Bronchitic irritation without specific signs in the right upper lobe bronchus. No signs of valve formation.

Case 309. Bilateral pulmonary tuberculosis since 1937. Left pneumothorax 1937—1941. Right pneumothorax since 1942. On bronchoscopic examination specific changes had once been shown in the right upper lobe, and these had been treated with silver nitrate. The cavities healed. In 1946, however, there was a cavity in the right upper lobe and tbb +. A new bronchoscopy was carried out and this was negative. After cautery of the adhesions on the right side, the cavity increased and there was risk of rupture of the cavity. Question: Valve mechanism? Aspiration recommended. *Bronchoscopy 1947:* Bronchial irritation without specific aspect by the opening to the right upper lobe. Aspiration performed. The cavity diminished somewhat after two further aspirations. Valve formation was not shown.

Case 390. Woman, 29 years. Right-sided pleurisy 1943. Bronchitis in September 1946. Roentgen examination of the lung showed fairly massive condensation in the left lymph glands and improvement behind the clavicle. The patient was examined bronchoscopically in October 1946 on a question of specific bronchial affection, and showed signs of non-specific bronchitis. 1 month later, signs of bronchitis and cavity at the top of the left lung together with tbb +. Bronchoscopy showed suspected bronchial changes in the left upper lobe. Treated with silver nitrate. A further month later. After obstruction of the phrenicus, the cavity had increased. Question: Valve mechanism? *Bronchoscopy:* Bronchitis picture in the left upper lobe bronchus without sure specific signs. Treated with silver nitrate. No bronchostenosis. After a further month it was found that the cavity had diminished. Control bronchoscopy showed unaltered status.

Case 126. Woman, 28 years. Pulmonary tuberculosis since 1940. Right pneumothorax August 1941—June 1945. In January 1945, progression on the left side with cavity. In August 1945, progression on the right side. Right pneumothorax taken up again. The cavity on the left side increased. Tbb +. The patient was examined bronchoscopically (Sept: 1945) on suspicions of specific bronchitis and non-specific signs of bronchitis were observed on the left side. After bronchoscopy there was congealment and fever. The left lung had become totally atelectastic. The cavity on the left side increased. Question: Valve formation on the left side? *Bronchoscopy Dec: 1945:* Suspected tuberculosis of the bronchial mucous membrane in the left upper lobe bronchus. On the right side, negative finding. Aspiration of the cavity on the left side. Fever after bronchoscopy, and 13 months later trouble from stagnation of the secretion. New bronchoscopy carried out with aspiration. The findings were negative.

Case 143. Man, 33 years. In 1946, left-sided pulmonary tuberculosis with cavity. In August 1946, left pneumothorax. The cavity increased. Pressure cavity? Aspiration recommended. Question: Valve mechanism? *Bronchoscopy Oct: 1946:* Slight bronchial irritation in the left upper lobe bronchus. Nothing specific. Aspiration.

Case 162. Woman, 37 years. Left-sided pulmonary tuberculosis 1941 with pneumothorax treatment. Jan: 1946, fusion of the right apex with pneumothorax treatment. However, the cavity increased after this. Question: Valve mechanism? Aspiration recommended. *Bronchoscopy:* Slight bronchial irritation on the right side, but without specific signs. Aspiration performed.

Case 354. Woman, 23 years, February 1942 primary tuberculosis and in June 1942 miliary dissemination. Autumn 1942 pleurisy. Pneumothorax for several months. Cured from November 1943 to 1945. Then developed a cavity on the left side of the pressure type. Phrenicus obstruction carried out in Dec: 1945. No effect on the cavity. Copious sputa. Tbb +. Question: Valve mechanism? Aspiration recommended. Bronchoscopy April 1946: Nothing specific. Aspiration carried out.

The investigation has thus shown that in not quite half of the cases examined with clinical suspicions or certain valve formation, changes could be shown which justified a belief in valve mechanism. The range of the bronchoscope is, however, limited and it is quite possible that a valve mechanism may lie outside its range. In a number of cases which gave a negative bronchoscopic picture with regard to valve mechanism, the clinical suspicions were so strong that one must consider such a mechanism with the greatest probability. This limited view through the bronchoscope would therefore be an explanation of the great number of negative cases. As being capable of forming a valve must be considered every bronchial stenosis, and especially suspect are those cases in which a stenosis is found in a swelling of the mucous membrane. The swollen membrane swells, in fact, further by compression of the lung tissue on expiration.

In the cases in which a positive answer is given as to the kind and degree of the valve formation, it is possible to intervene in the most suitable way. First the thoughts turn to a valve formation caused by granulations. These may be pendulous or they may also swell on expiration. By taking away the granulations through the bronchoscope with an instrument, the cause of the valve itself should be removed. No such case is to be found in our material. One may also consider that a stenosis which forms a valve may be dilated and the valve formation thus removed. As has, however, been stated before, the prognosis in bronchial dilation is particularly bad. In addition, by reason of the trauma which a dilation always causes, a further swelling occurs, especially in those kinds of stenoses which are composed of swellings of the mucous membrane. And these kinds of valve stenoses are the more common. In these cases the opposite result is obtained to that desired. With regard to aspiration of pressure cavities and the results thereof in valve formation, reference is made to the section dealing with aspiration treatment.

Discussion: In a certain number of cases with clinical signs

of a valve mechanism, it has been possible to show stenoses through the bronchoscope which make a valve formation probable. It has been maintained (Bernou, Kajser, Huizinga) that an oedema in the bronchial stenosis itself may cause a valve mechanism. It has also been seen that of the 6 described cases of bronchoscopically suspected valve formation, 5 were fairly acute changes with more or less pronounced oedema in the stenoses. The sixth case was a rigid, funnel-shaped opening, with a deep-lying stenosis in suspected specific or healed specific affection of the bronchus. Occasionally it is also possible to see in the bronchoscope clearly how the bronchial lumen is constricted during expiration, especially if the patient takes long, deep breaths with a little forcing.

Treatment of valve mechanism has been attempted partly with aspiration, and partly with silver nitrate treatment of the actual specific bronchitis. In no case has this kind of treatment met with any great success. Other treatment (not bronchoscopic) has had to be resorted to. In one case the cavity healed after occlusion treatment, but in the other 5 cases the treatment was broken off. No case has occurred of the removal of the granulations in a stenosis bronchus in order to stop the valve action.

e. Atelectasis.

In the study of the different indications for bronchoscopic examination, it will be found that nearly all the authors have included atelectasis. By atelectasis is meant a space devoid of air within the lung, where the cause of the lack of air is not an exsudation in the alveoli which would force out the air, but is dependent on other causes, first and foremost on a bronchial occlusion with resorption of the air peripheral to the impediment. If the occlusion is removed, the parenchyma may again become air-bearing.

Bruin and Gerlings point out the importance of bronchoscopically discovering the cause of the atelectasis and if possible of removing the same in order, in this way, to avoid later complications. First and foremost these authors point out the danger of secondary bronchiectasis. Coryllos points out that all forms of bronchial tuberculosis may produce stenoses and consequent atelectasis in the lungs. Farber and other authors point out the

great danger of the occurrence of an atelectasis which always exists in carrying out a pneumothorax on a lung with bronchial tuberculosis (will be treated later in connection with pneumothorax). Also in the case of large lymphadenites the stenosis of the bronchus may be so heavy that an atelectasis will arise; this is described by, amongst others, Wissler (dealt with here in connection with lymphadenitis).

With regard to atelectasis, Lloyd and Budetti point out that designation is occasionally used in a clinical sense as soon as a shadow is seen on the lung in roentgen examination. The authors, however, point out that atelectasis has a somewhat different meaning for the bronchoscopist. They set forth the following views which atelectasis gives the bronchoscopist: a) a healed pulmonary lesion with draining bronchus closed by healthy scar, b) a healed pulmonary lesion where the bronchus remains open and the mucous membrane is intact, c) an obstruction to the bronchus in the absence of pneumothorax or d) an obstruction to the bronchus in the presence of pneumothorax.

Alexander points out the danger of fusion in an atelectasis with subsequent abscess formation. Another danger consists in the fact that the lung does not expand again after a pneumothorax, but becomes hardened and affected with a secondary infection. Even in these cases fusion may take place and give rise to formation of an abscess.

Ameuille and Lemoine describe cases of atelectasis which, on bronchoscopic examination, showed themselves to be dependent on tuberculosis of the bronchial mucous membrane with stenosis. Lemarié describes cases of massive, total atelectasis in the lung depending on tuberculosis of the bronchial mucous membrane in the main bronchus, and this condition was treated by aspiration of the cheese-like masses which by this treatment led to resolution of the atelectasis.

Dohlman considers that by removing the granulations in a bronchus, it is possible to restore the passage in the bronchus and thereby cut an atelectasis.

My own investigations.

107 patients were sent for bronchoscopy with atelectasis or suspected atelectasis. The question has usually been as to whether

any cause for the atelectasis could be shown. The results of bronchoscopy have been those given in table 4.

Specific or suspected specific affection of the bronchus with more or less pronounced bronchostenosis	27 cases
Bronchostenosis without specific bronchitis being present	13 "
Perforated lymphadenitis with bronchostenosis	3 "
Bronchostenosis after occlusion cautery	1 "
Tumour	2 "
Negative bronchoscopic finding	61 "
Total	107 "

Table 4.

In view of Westermarck's observations that in damage by silent force to the chest cage an atelectasis may be produced in the lungs by the bleeding, an investigation has been made of the negative cases concerning hemophthisis in anamnesis. It was found that 8 of these cases had had a major haemorrhage between 6 and 1 months before bronchoscopy.

The table shows that stenosis, to a more or less marked degree, is present in a large number of cases of atelectasis. Altogether there were 46 cases, i. e. just short of half the cases.

Atelectasis had occurred in connection with the carrying out of pneumothorax in 11 cases; 9 were total and 2 lobar atelectasis. In 3 cases the bronchoscopic findings showed a bronchostenosis, but the other cases had a negative finding. This question is touched on later with reference to bronchoscopic examination for pneumothorax.

With regard to the great number of negative findings in bronchoscopic examinations for atelectasis, it is of great interest to compare the extent of atelectasis with the other findings. Since it has not always been possible with certainty to decide whether an atelectasis was present or not, an investigation has also been made into which atelectases have been considered certain by the lung specialist, and which have been classified as suspected atelectases. The comparison is made in table 5.

Entire lung with atelectasis:

Positive findings: 8 cases.

Specific bronchial changes with stenosis	3
Specific bronchial changes and pneumothorax	2
Bronchostenosis and pneumothorax	1
Irritation-free stenosis	1
Adenitis perforation	1
Total	8

Negative findings: 9 cases.	After pneumothorax	6
	After hemopthysis	1
	Clinical lymphadenitis	1
	Others	1
	Total	9
Lobar atelectasis:		
Positive findings: 35 cases.	Specific or suspected specific bronchial changes	11
	Specific bronchial changes with stenosis	8
	Irritation-free stenosis	10
	Adenitis perforation with stenosis	2
	Specific bronchitis with suspected atelectasis	1
	After attempt at occlusion	1
	Tumour	2
	Total	35
Negative findings: 23 cases.	After pneumothorax	2
	After hemopthysis	2
	Suspected atelectasis	2
	Others	17
	Total	23
Less extensive atelectasis:		
Positive findings: 3 cases.	Specific bronchial changes	2
	Clinically suspected lymphadenitis, bronchoscopically confirmed stenosis	1
	Total	3
Negative findings: 29 cases.	Suspected atelectasis	7
	After hemopthysis	5
	Others	17
Table 5.	Total	29

It is clear from the table that the less extensive the atelectasis is, the more infrequently is it possible to show a cause for the same by means of the bronchoscope. A relatively large number of cases of total lung atelectasis occurred in carrying out pneumothorax, and in 6 of these cases no cause was found for the atelectasis. These questions will be gone into later in connection with bronchoscopy in carrying out pneumothorax.

The bronchoscopic treatment of atelectases has been cautery with silver nitrate of the tuberculosis of the bronchial mucous membrane in the stenoses present in 23 cases. In 4 cases the atelectasis disappeared in connection with the treatment, in 17 cases the condition was unchanged and led to other treatment and in two cases the treatment had to be broken off on account of the deteriorated general condition of the patient. Otherwise the treatment has consisted in aspiration of the secretion in the bronchus which led to the part of the lung affected with atelectasis. By

means of this treatment, cases of atelectasis have occasionally, but not definitely, been relieved.

In one case of total atelectasis, a stenosis of the main bronchus was treated by dilation of the bronchial lumen, and in this way the atelectasis was resolved.

Discussion: Several authors maintain the importance of bronchoscopically examining cases of atelectasis, and if possible of determining in this way the cause of the atelectasis. Coryllos also pointed out that all forms of tuberculosis of the bronchial mucous membrane can produce a bronchostenosis with subsequent atelectasis. An atelectasis may mean a tumour, as was the case in 2 of our cases. This is true also of those cases in which pulmonary tuberculosis is suspected or is present. The large number of negative findings in bronchoscopy of cases of atelectasis does not diminish the importance of this examination in this kind of lung complication. Cases may be found, especially those with less extensive atelectasis, where the bronchial occlusion lies very far on the periphery, so that the range of the bronchoscope is not sufficient to allow them to be discovered.

The bronchoscopic treatment of atelectasis has not been encouraging. Dohlman has proposed treatment of stenoses consisting of granulations in such a way that the granulations are removed by means of an instrument, and in this way a passage made in the bronchus. No case which was suitable for such treatment has come under our care.

f. Hemopthysis.

A frequent indication for bronchoscopy is, according to Ch. Jackson, hemopthysis. The commonest cause of hemopthysis is not tuberculosis, and he shows a series of bronchoscopic examinations with hemopthysis not of tuberculous origin in 436 cases. In cases of extensive haemorrhage, for purely technical reasons it is necessary to wait some days before undertaking the examination. Occasionally, however, the indication for bronchoscopy may be to stop the bleeding.

The indication for bronchoscopy in hemopthysis is usually on tuberculous material of purely differential diagnostic interest. Sometimes the lung specialist has also a purely diagnostic interest, and this is as a rule a question of the source of the bleeding.

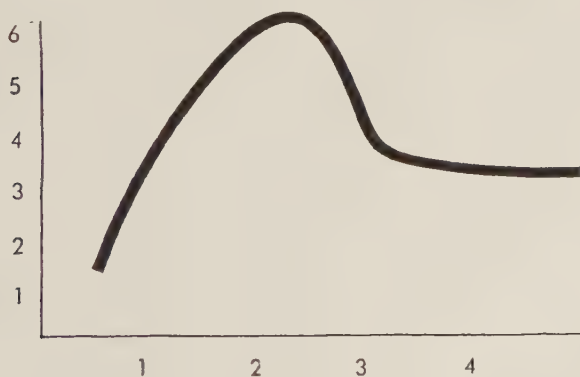
Cohen and Wessler point out that ulcerations and granulations seldom give rise to hemoptysis, while they have several times observed glands in the lymphatic region give rise to extensive haemorrhages in the greater bronchi through arrosion.

Myerson includes hemoptysis among the contraindications to bronchoscopy.

My own investigations.

In 18 cases the question from the lung specialist was: Cause of the hemoptysis? The question concerned, in by far the greater number of cases, a haemorrhage of doubtful origin. There was no certain record that it was a question of haemorrhage from a tuberculous centre, but there was good reason to believe that it was a case of tumour or rupture of a vessel of non-tubercular origin. In none of the cases examined was it possible to give a positive answer to the question where the haemorrhage came from. In 7 of the cases the lung specialist could find no pulmonary tuberculosis, but the patient had been admitted to the sanatorium for investigation of his hemoptysis. In examining the time of the bronchoscopy in relation to the time of the hemoptysis, it is found that a rather long time elapsed between the hemoptysis and the bronchoscopy. One patient was examined bronchoscopically 10 days, and one 11 days after the cessation of the haemorrhage, and the others 1—4 months after the haemorrhage. See table 6.

Number of cases.



Months after haemorrhage.

The cause of the constant negative results in these examinations must be sought in the fact that bronchoscopic examination is carried out much too long after the haemorrhage. Myerson's warning against bronchoscopy in fresh hemoptysis may perhaps have played a certain part in this. Bronchoscopy is, however, carried out without inconvenience and without hesitation in fresh hemoptyses of other kinds, for example, in tumours, so that there is no need to have doubts as to bronchoscopy in haemorrhage in those patients who may have pulmonary tuberculosis as a cause of the haemorrhage. In a probably rather larger number of cases of suspected tuberculous hemoptyses it is not a question of tuberculous origin of the haemorrhage. In our material 7 patients were clinically and bronchoscopically free from tuberculosis. It is so much more important in these cases to have the diagnosis of non-tuberculous hemoptysis verified. Experience in this investigation points to early bronchoscopy in cases of obscure hemoptysis.

After a fresh haemorrhage, the patient is as a rule in a more or less pronounced state of shock for some hours or some days. During this time bronchoscopy should not be undertaken, since the patient is also somewhat affected by it. In active haemorrhage there is a certain difficulty in obtaining satisfactory anaesthesia for carrying out the operation, so that it is better to wait. The time of waiting should, however, not be carried so far that the haemorrhage has ceased when the operation is undertaken. In that case there is great risk of a negative answer.

In one of our cases (no. 43) total atelectasis of one lung occurred in connection with the hemoptysis. In this case, the bronchoscopy, too, was negative, but it was first carried out 2 months after the hemoptysis. Intervention in these extensive haemorrhages may, as Jackson maintained, be of curative value to the atelectasis itself.

Discussion: A number of authors have placed hemoptysis as a contraindication to bronchoscopy (Myerson). However, if the haemorrhage is of an unknown kind, bronchoscopy should be performed at an early stage, as is maintained by Jackson. Our investigation illustrates this in a remarkable way. If bronchoscopy is not undertaken at an early stage, or preferably before the cessation of the bleeding or immediately afterwards, it is easy to be

unable to discover the source of the bleeding. Even if the patient has pulmonary tuberculosis with haemorrhage, which for certain reasons is suspected to be not of a tuberculous kind, it is necessary to be active with the bronchoscope if there is to be a prospect of finding out the cause of the bleeding.

Jackson has also pointed out that bronchoscopy should often be carried out in major haemorrhages in order to prevent an atelectasis from arising. One of our cases suffered a total atelectasis of one lung just after a major haemorrhage. Unfortunately bronchoscopy was not carried out till 2 months afterwards. The bronchoscopic finding was negative in spite of the fact that the atelectasis continued.

We have always taken up the position that if a bronchoscopic examination of a hemoptysis is to be made, it should be made as early as the circumstances allow, preferably before the haemorrhage has quite ceased.

g. Occlusion treatment.

In the treatment of valve mechanism, the different stenoses of the cavernous bronchi were touched on. The most pronounced bronchostenosis does not permit the passage of air in either direction. Coryllos has observed that in a certain degree of stenosis a quick collapse of the cavity is obtained, and has advanced the theory that healing of the cavity takes place through occlusion of the cavernous bronchus. The speed of the healing itself, says he, depends on the thickness of the cavity wall. The cause of the healing of the cavity would be that the tubercular bacilli are aerobes and they receive no oxygen on blocking of the cavernous bronchus. They therefore die. The air in the cavity space is reabsorbed and the cavity then disappears. On a post-mortem material of 7 cases, besides one not quite typical case, Mille has shown healing of the cavity depending on an occlusion of the cavernous bronchus. He describes healing of cavities in different stages and gives several examples. The final stage of the tuberculous bronchial affection is a disappearance of the bronchial lumen with scarring. When the bronchus is closed, the exudation disappears. The wall of the cavity softens little by little and is transformed into a thin, fibrous wall. Granulation tissue is formed into a connecting tissue capsule, and sometimes there is calcifica-

tion in this mass. In rare cases a mixed infection arises within the closed cavity; this is probably rare because an anaerobous infection is of relatively rare occurrence in these cavities. Pagel and Simmonds consider that healing of the cavity takes place either because the cavity is healed by an epithelium which grows in from the bronchus, or by fibrous transformation of the cavity. It may also take place by calcification of the cheese-like masses in the cavity.

Poinso and Puorsines describe spontaneous healing of cavities in patients who died from other diseases and point out the great part played by occlusion of the bronchus in healing. Healing is in all probability to be ascribed to the obliteration of the cavernous bronchus, after which there is an atelectasis in the neighbourhood and then secondarily a sclerosis of the cavity itself. Schubert also maintains the importance in the healing of a cavity of the cavernous bronchus closing itself. Berblinger considers that the disappearance of the lung cavity depends on the cavernous bronchus closing itself by a scarred constriction after which the cavity is transformed into a scar.

Opposition has by no means been lacking to these theories. Thus le Carboulec turns against the theory that a cavity cannot heal without bronchial obliteration. By opening the cavity widely and scraping out the cheese-like centres, the cavity heals in spite of the cavernous bronchus remaining open. Westermarck also denies that occlusion of the cavernous bronchus must be a condition for healing of the cavity. He points out also that Mille's cases should be handled with other methods, amongst others, pneumothorax. He even maintains that the atelectasis which arises on the periphery of an occlusion is directly unfavourable to the healing of the tuberculous process.

For supporters of the theory set up by Coryllos it has been tempting to produce an occlusion of the cavernous bronchus artificially in order to obtain the healing of the cavity in this way. Already in 1934 Adams described a sure method by which, in 85 % cases, he obtained complete stenosis in a healthy bronchus of the greater bronchi in dogs. He never had any complications with the treatment described. Adams and Livingstone demonstrated, in fact, experimentally on dogs that with a 35 % silver nitrate solution they could, in most cases, obtain total stenosis of the bronchi. With a 15 % and a 50 % solution they obtained

stenoses less often. With a 75 % solution, deep necroses arose. The cartilage offered the most powerful resistance. The epithelium, however, was regenerated fairly quickly. He then extended his attempts by producing a tuberculosis experimentally on dogs, and then treating it by means of occlusion therapy. He obtained very good results. In the collapsed parts of the lung round an occlusion, the tubercles were small and free from bacilli, while in those parts which were not subjected to occlusion, and therefore contained air, the centres were confluent, greatly changed and containing cheese-like matter and very rich in bacilli. It was easily possible to obtain occlusion and complete collapse when no stream of secretion was present in the bronchus, while the same was very difficult if secretion was present. Dohlman repeated Adams' attempts but did not obtain the same good results as Adams. Dohlman considers that the successful stenoses in Adams' material are attributable to a too short observation period. The stenoses would in fact disappear little by little, and the bronchus open again. Dohlman and Kernan too say that as long as the secretion continues it is impossible to obtain complete occlusion. Lloyd writes in 1943 that no success was obtained with artificial closing of the bronchi, and that this depended on factors prevailing behind the region accessible by means of the bronchoscope.

The means used for obtaining stenosis of the bronchial lumen have been cautery with a silver nitrate solution, usually 30 %, lactic acid of different concentrations and galvanic or diathermic cautery. Dohlman considers that stenosis of a healthy bronchus cannot be produced by means of silver nitrate cautery. Skoog says that silver nitrate has only a superficial cauterising effect and considers it doubtful if it has in the main any shrivelling effect on the mucous membrane. He bases his contention on microscopic studies. Supported by American authors, Dohlman gives a warning against the use of cautery because of the risk of haemorrhage, which according to the data furnished by the same authors is present to such a high degree that haemorrhages have occurred which have proved fatal.

A condition, however, for the entirely non-surgical treatment which occlusion with shutting off of the pus focus implies is that the cavity is free from secondary infection. If, however, the secondary infection is caused by aerobe bacilli, this infection too

will be removed by an occlusion. Mille has also put forward the surmise that anaerobe infections are very rare in the cavities, and that for this reason there are so seldom complications in the form of lung abscesses. It is also desirable to have the shut-off part of the lung free from lung parenchyma, in the first place in order to prevent the occurrence of emphysema (Steiner) or atelectasis (Westermarck) peripheral to the stenosis. This is a desire which it is very seldom possible to satisfy in artificial occlusion treatment.

Gravesen says that it is important to procure occlusion of the cavernous bronchus in order to heal the cavity, and it is especially good as a complement to Monaldi treatment. This artificial occlusion treatment is therefore an important method of bronchial treatment via the bronchoscope.

Pagel and Simmonds describe 6 cases of healing of cavities through closing of the cavernous bronchi. They ascribe the rapid healing in a certain degree to the reabsorption of air in the cavity which takes place after the closing of the cavernous bronchus, and which causes a collapse of the cavity itself. The closing may take place in different ways, in their cases either through an obstructive bronchial affection or by plugs of the cheese-like mass. These authors consider 4 weeks as the minimum for the disappearance of a cavity. Düggeleli has treated residual cavities by introducing a flexible diathermy cauterizer into the cavernous bronchus, and coagulating the opening of the cavity under fluoroscopic control at one or more sessions. He had thereby obtained good healing in 9 cases in the course of from 4—10 months. Leegaard has also had good results from treatment of residual cavities, but only by treating the existing bronchial tuberculosis.

My own investigations.

Thirtythree cases were sent in with a request for occlusion treatment of the cavernous bronchus. In addition, one case of rapid spontaneous healing was sent in for investigation, since the doctor in question suspected spontaneous bronchial occlusion. In 26 cases treatment was carried out with galvano-cautery and in one case with 50 % silver nitrate solution. In 6 cases the occlusion treatment was declined. Of those treated with galvano-cautery, the division was as follows:—

Aspect of bronchus	Healing of cavity	Unimproved or treatment broken off
Healthy	2	9
Previously some stenosis	—	1
Tuberculosis of the bronchus:		
muc: membrane	5	9

The only case treated with silver nitrate showed no tendency to heal.

In 2 cases occlusion treatment was refused because it was not possible to locate the cavernous bronchus through the bronchoscope. In one case the treatment was refused because the cavernous bronchus was so wide that occlusion of it was considered out of the question. In one case a specific, and in 2 cases a suspected specific tuberculosis was treated with silver nitrate instead of the requested occlusion treatment.

Short examination of the cases:

1. Healthy bronchus: a) Healed:

Case 10. Man, 38 years. Old pulmonary tuberculosis, at least 16 years. Mainly right-sided changes. Thoracoplasty on the right side 3 months before the requested occlusion treatment. Residual cavity after the plastic operation. Tubercular bacilli positive. On bronchoscopy, no changes observed. Cautery treatment of the cavernous bronchus begun and repeated at about 4 weeks' intervals. At the fourth cauterization the commencement of stenosis could be observed. After the fifth cauterization there was a little hemoptysis. Altogether 12 cauterizations in the course of 10 months. Residual cavity disappeared, and freedom from bacilli was obtained. The final result was complete stenosis of the cavernous bronchus.

Case 153. Man, 25 years. 4 year old pulmonary tuberculosis. Right pneumothorax one year previous to the commencement of the occlusion treatment, and, on right side apex-plasty 6 months before. Negative bronchoscopic findings. 2 caustic treatments were carried out and the cavity disappeared. The patient was free from bacilli. No stenosis could be observed at the second bronchoscopy and control bronchoscopy was not carried out since the patient was cured.

b) Unimproved or treatment broken off:

Case 59. Man, 30 years. Fresh pulmonary tuberculosis. Cavity right apex. Attempt at pneumothorax failed. Negative bronchoscopy finding. 3 cautery treatments without stenosis. Not free from bacilli. When the fourth treatment was to take place, the patient had a hemoptysis and the treatment was not continued.

Case 79. Woman, 19 years. Pulmonary tuberculosis for 6 years. Good regression after right pneumothorax, later left pneumothorax too. One year previous to treatment of left lung retrogression of the cavity. 2 caustic treatments were carried out on the healthy cavernous bronchus and a certain degree of stenosis was obtained. Because of lengthy subfebrile temperature, further treatment was not given. The cavity remained, atelectasis occurred in the upper lobe and the bacilli remained positive.

Case 104. Woman, 26 years. Left-sided apex changes with atelectasis 2 years before the commencement of the treatment. Negative bronchoscopic findings in the two previous examinations. Because of the subsisting cavity of the pressure type, aspiration and occlusion treatment was recommended. The latter was later performed with galvano-cautery. At the next treatment the patient was taken ill during the administration of the anaesthetic and refused further bronchoscopy. The cavity remained. Death 7 months later.

Case 164. Man, 32 years, 5 years before the commencement of the occlusion treatment, pulmonary tuberculosis with cavity in left apex. Extrapleural pneumolysis 3 years later. Bronchial fistula to the operation hole 6 months after. Attempt at closing the fistula bronchus recommended. 3 cautery treatments carried out via the bronchoscope, but no tendency to formation of a stenosis. The fistula did not heal, and there was no freedom from bacilli. The treatment was broken off because the patient was rather impressed by it.

Case 214. Woman, 36 years. Old pulmonary tuberculosis with progression. Bilateral cavities with Monaldi drainage on the left side. Negative bronchoscopic findings. Cautery of the cavernous bronchus carried out. Patient had high fever after bronchoscopy. Renewed bronchoscopy for aspiration of the cavernous bronchus showed no tendency to stenosis. The patient had a very high temperature after this examination too. Death 6 months later.

Case 251. Man, 36 years. Old pulmonary tuberculosis with cavity. Apex plasty on the left side with residual cavity. Occlusion treatment recommended. Negative bronchoscopic findings, 3 cautery treatments carried out. The cavity was unchanged, and no freedom from bacilli was obtained. Control showed no tendency to stenosis. The treatment was broken off because of this.

Case 291. Man, 34 years. Fresh pulmonary tuberculosis with giant cavity. Monaldi drainage. The cavity remained in spite of this, and was seen to be without improvement on bronchoscopic examination. 1 month later occlusion treatment was recommended. 7 cautery treatments were carried out. Granulations arose in the cavity, but the cavity did not collapse. Freedom from bacilli was not obtained. Thoracoplasty was carried out later but this did not free patient from bacilli.

Case 334. Man, 24 years. Fresh pulmonary tuberculosis with cavity. Bronchoscopy 1½ years previously showed once non-specific changes and twice negative. On account of the pressure cavity there was aspiration and occlusion treatment. The treatment was not concluded because of deterioration of the general condition. Death 1 year later.

Case 404. Man, 35 years. Pulmonary tuberculosis for 3 years. Large cavity in the right lower lobe. Suspected bronchial cavity to the empyema cavity. Occlusion treatment of the bronchial fistula recommended. A branch bronchus in the lower lobe was a little swollen and was therefore interpreted as the fistul bronchus. In all there were two caustic treatments. High fever after treatment and not free from bacilli. Treatment broken off. Death 6 months later.

2. Previous bronchial stenosis of non-specific kind at the time:

Case 24. Woman, 22 years. Fresh tuberculosis of the lung with cavity of the pressure type. Because of the rise in temperature before bronchoscopy, this was not carried out the first time it was requested. Obstruction of the phrenicus was, however, carried out. 2 months later stenosis with oedema in the cavernous bronchus was observed, but not with certainty specific changes were present. One cautery treatment was carried out, but the treatment was not continued because of deterioration of the general condition. The cavity increased and the patient was positive for bacilli all the time.

3. Specific or suspected specific bronchitis: a) Healed:

Case 35. Man, 24 years. Fresh pulmonary tuberculosis and cavity with nephritis. Pneumothorax unsuccessful and Monaldi drainage was planned. A con-

dition was, however, that a prospect for bronchial occlusion was present. Laryngeal tuberculosis. At the first bronchoscopic examination no sure specific bronchitis signs had been observed, but later they were to be seen. 5 cautery treatments were carried out in the dorsal branch bronchus of the upper lobe bronchus. Thoracoplasty was carried out during the treatment and was supplemented by caustic treatment of the tuberculous bronchial mucous membrane. After the fifth cautery treatment no bronchial lumen could be observed. The patient was then free from bacilli and the cavity was not visible.

Case 90. Man. 43 years. Old tuberculosis with cavity in left apex. Bronchoscopically examined at another hospital and treated with silver nitrate. Thoracoplasty one year previous to the requested occlusion treatment with residual cavity. Tuberculosis of the bronchial mucous membrane near the cavernous bronchus. After 12 caustic treatments, stenosis with granulations in the cavernous bronchus. Free from bacilli. Residual cavity not demonstrable.

Case 92. Woman. 20 years. Fresh pulmonary tuberculosis with cavity in left apex. At the first bronchoscopic examination the findings were negative. Later suspected bronchial affection of the cavernous bronchus. Treated with silver nitrate 3 times and then atelectasis was produced. Thoracoplasty was performed. Residual cavity remained, treated by cautery 6 times. There was not complete stenosis but freedom from bacilli was obtained and a cavity could not be shown.

Case 302. Man. 34 years. 1 year old pulmonary tuberculosis with cavity in apex. Tuberculosis of the bronchial mucous membrane in the cavernous bronchus. Satisfactory collapse with pneumothorax, but the cavity did not collapse. Continuous positive bacilli. Occlusion treatment requested. On first examination slight constriction of the cavernous bronchus and later specific changes. After 6 cautery treatments complete stenosis and healing of the cavity with freedom from bacilli.

Case 311. Man. 23 years. Fresh pulmonary tuberculosis with cavity in left upper lobe. Residual cavity after pneumothorax. At the first examination there were no specific changes in the cavernous bronchus, but later there was a specific affection in the same. During the course of 1½ year there were 16 cautery treatments, and complete occlusion was obtained with healing of the cavity and freedom from bacillus. Two control bronchoscopic examinations were made and the clinical control also showed healing.

b) Not healed:

Case 53. Man. 36 years. Old pulmonary symptoms. Asthma. Tubercular bacilli positive, large cavity. Occlusion treatment recommended. On bronchoscopy no changes in the cavernous bronchus could be seen, 3 silver nitrate treatments were carried out but the cavity showed a rapid tendency to increase. Bacillus free and the cavernous bronchus showed a strong tendency to stenosis. The cavity, however, did not collapse. Thoracoplasty was performed in order to heal cavity. Cavity thereafter healed.

Case 111. Woman. 32 years. Fresh pulmonary tuberculosis with cavity. Pneumothorax produced atelectasis. Bronchoscopic examination showed extensive tuberculosis of the bronchial mucous membrane. Occlusion cautery recommended, because the cavity did not collapse in spite of the pneumothorax. 10 cautery treatments carried out and the process receded somewhat but a marked stenosis in the main bronchus appeared. PAS treatment and thoracoplasty later, but in spite of this the cavity did not heal.

Case 118. Woman. 22 years. One year old pulmonary tuberculosis with cavity at the left apex. Pneumothorax unsuccessful. Thoracoplasty planned. Bronchoscopic examination showed specific bronchitis in the cavernous bronchus. Monaldi drainage was then planned, and at the same time occlusion treatment was requested. Tuberculosis of the bronchial mucous membrane in the left

upper lobe bronchus was observed on bronchoscopic examination. 4 cauterly treatments were carried out, and a marked stenosis was obtained, although not complete. The cavity did not collapse. After thoracoplasty the cavity healed.

Case 238. Man. 25 years. Old pulmonary tuberculosis. No typical cavity. Pneumothorax on the left side, and thoracoplasty on the right. Bacilli present. Bronchoscopic examination showed a specific change in the right upper lobe bronchus. Occlusion treatment recommended. 10 cauterly treatments were carried out, but complete stenosis was not obtained. Thoracoplasty was performed again but there was no healing.

Case 73. Man. 28 years. Old pulmonary tuberculosis with cavity and bronchial tuberculosis in the cavernous bronchus. Pneumothorax on the left side and a residual cavity near the left lymphatic region. Occlusion treatment requested. A number of silver nitrate treatments were carried out and later 2 caustic treatments in order to obtain occlusion. All in vain. Oleothorax without any effect. Remained positive for bacilli and cavity subsisted.

Case 78. Woman. 28 years. Old, progressive pulmonary tuberculosis with atelectasis and cavity in right apex. Pneumothorax and obstruction of the phrenicus was performed without healing of the cavity. On bronchoscopic examination a suspected specific affection was observed in the right upper lobe bronchus. 3 cauterly treatments, but no healing of the cavity. Not free from bacilli. Death in connection with the thoracoplasty operation.

Case 150. Man. 37 years. Old pulmonary tuberculosis with cavity on right side. In spite of phrenicus exheres the cavity increased. Occlusion recommended. At the bronchoscopic examination suspected specific changes were observed in the right middle lobe bronchus. 2 cauterly treatments were carried out, but further treatment had to be broken off because of deteriorated general condition. At the last bronchoscopic examination the cavernous bronchus was filled with granulations. Freedom from bacilli was not obtained. Death 1 year after the treatment.

Case 160. Woman. 37 years. Old pulmonary tuberculosis in the right lower lobe. Healed after Monaldi drainage and cauterly of the cavernous bronchus because of tuberculosis of the bronchial mucous membrane. 3 cauterly treatments carried out for occlusion. Complete stenosis was not obtained. Because of deteriorated general condition the treatment was broken off. The cavity was not clearly visible, but freedom from bacilli was not obtained.

Case 274. Woman. 32 years. Old pulmonary tuberculosis with pneumothorax. Later pneumolysis and oleothorax. Bronchial fistula supervened. Bronchoscopy showed a suspected specific bronchial affection. 2 cauterly treatments were carried out in order to close the bronchial fistula, but they were unsuccessful. The treatment was broken off. Later, tuberculous meningitis, treated with streptomycin.

One case was treated with silver nitrate to obtain occlusion of the cavernous bronchus:

Case 299. Man. 10 years. Fresh cavernous pulmonary tuberculosis. Pneumothorax failed. Occlusion treatment recommended. Bronchoscopy showed no specific changes. 3 silver nitrate treatments performed. New bronchoscopy showed that the bronchus was healing, but there was no sign of effect of the silver nitrate treatment so the treatment was broken off.

In six cases the proposed occlusion treatment was declined:

Case 4. Man. 18 years. 2 year old cavernous pulmonary tuberculosis. Pneumothorax ineffective. Occlusion treatment recommended. Negative bronchoscopic findings. The cavernous bronchus could not be localised.

Case 245. Woman. 32 years. 3 year old pulmonary tuberculosis with cavity.

Monaldi drainage planned, but occlusion was requested at the same time. Treatment was, however, refused because the cavernous bronchus could not be localised. Death one year later.

Case 6. Woman. 22 years. 3 year old pulmonary tuberculosis with cavity and healed tuberculosis of the bronchial mucous membrane. Since bacilli were present again and the cavity reappeared, occlusion was requested. The cavernous bronchus was very wide, so treatment was refused.

Case 100. Woman. 36 years. Old cavernous pulmonary tuberculosis. In spite of pneumothorax, the cavity did not collapse. Bronchoscopy showed a suspected specific affection in the cavernous bronchus. Occlusion treatment requested. After 3 silver nitrate treatments of the bronchial changes, the cavernous bronchus was slightly constricted. The cavity was not visible.

Case 103. Man. 42 years. 5 year old pulmonary tuberculosis with pneumothorax, but no collapse of the cavity, and not free from bacilli. Bronchoscopy showed redness of the cavernous bronchus. Occlusion treatment was requested, but the cavernous bronchus was cauterized with silver nitrate; the bronchial changes then healed, the cavity disappeared and the bacilli were negative. Slight bronchial stenosis appeared.

Case 326. Man. 42 years. Old pulmonary tuberculosis with cavity, which was treated with Monaldi drainage 1 year before the bronchial treatment. The cavity did not collapse. Bronchoscopy showed tuberculosis of the bronchial mucous membrane. After 5 treatments with silver nitrate, the bronchial changes healed, the cavity collapsed and freedom from bacilli was obtained. 2 months later, after an angina, the cavity reappeared and the general condition deteriorated. The treatment was then broken off.

A particularly interesting case with spontaneous occlusion of the cavernous bronchus and healing of the cavity was also investigated:

Case 295. Man. 33 years. Old pulmonary tuberculosis with cavity in the left middle region. 3 years later no cavity was visible. Bacilli were also negative then. Bronchoscopy showed the cavernous bronchus to be completely closed by firm granulation tissue.

A survey of the cases with healthy cavernous bronchus treated shows that in only two cases of residual cavity after thoracoplasty was successful stenosis obtained with healing of the cavity and freedom from bacilli. In all the other cases, stenosis of the cavernous bronchus was unsuccessful, and the cavity did not heal. In 7 of the unsuccessful cases, treatment was suspended because of lack of success in the attempts at stenosis. In the 2 other cases, the treatment was broken off for other reasons, and therefore control bronchoscopy was not carried out.

In one case of stenosis of the cavernous bronchus, but without specific or suspected specific changes, occlusion was not complete, the cavity did not heal and bacilli were positive.

In cases with a specific or suspected specific bronchial change in the cavernous bronchus, complete stenosis was obtained in 4

cases with healing of the cavity and freedom from bacilli. One of these cases was a residual cavity after thoracoplasty. In the 5th case which healed, complete stenosis was not produced, but nevertheless the cavity healed and there was freedom from bacilli. By the stream of secretion coming from the bronchus, it could be observed that the stenosis was not complete. This case was a residual cavity after thoracoplasty. In 9 cases in this group, healing of the cavity and freedom from bacilli was not obtained. Of these, there were 4 cases which after treatment showed a marked stenosis but still did not heal. 3 of them did not heal either after other operations, but the fourth healed after thoracoplasty. They were clearly very difficult cases as regards healing of the cavity. In 2 of the cases, treatment was broken off before it had been completed.

In one case a healthy cavernous bronchus was treated with 50 % silver nitrate solution without any stenosis at all being produced on the bronchus, and without any healing effect on the cavity. The treatment was therefore broken off.

Occlusion treatment must in principle be refused if the cavernous bronchus cannot be localised with certainty. Attempts at stenosis must also be discouraged when the bronchial lumen is so large that it cannot be considered possible to produce complete stenosis. This was done altogether in 3 cases.

It may be discussed whether an attempt should be made immediately at occlusion treatment if a specific bronchitis can be shown in the cavernous bronchus, and if the lung specialist concerned has proposed occlusion treatment. Leegaard obtained good results in treatment of tuberculosis of the bronchial mucous membrane in residual cavities after thoracoplasty. In view of this, 3 cases with specific bronchitis in the cavernous bronchus were treated with a 50 % solution of silver nitrate, instead of with occlusion cautery. In 2 of the cases the cavity healed and freedom from bacilli was obtained, but in the 3rd case certainly at first the cavity healed, and freedom from bacilli was obtained. After two months, however, both the bacilli and the cavity reappeared. Since the general condition deteriorated, further treatment was broken off.

Perhaps the most interesting of all the cases is the healed cavity after spontaneous stenosis of the cavernous bronchus. The clin-

ician also suspected that this was the case and desired to have his suspicions verified.

Discussion: The experience of the above cases shows that it is very difficult to produce so marked a stenosis on a healthy bronchus as to obtain healing of the cavity. This is contrary to Adams' data, and is more in agreement with attempts made by Dohlman and the observations made by Lloyd. It appears as if the secretion makes the closing of the bronchus more difficult, or even renders it impossible. A swelling of the mucous membrane may produce a momentary stenosis, but after about 3 weeks the swelling disappears and in most cases the passage is restored. Therefore, after this period, new cautery must be performed. A better effect is, however, obtained on cavernous bronchi which show specific changes, and the more changed they are, the more marked is the stenosis. It is quite justifiable to ask oneself the question: "Is it the treatment or the specific process itself which produces the stenosis?" In one case stenosis was even produced without cautery treatment. The answer must be that it is a combination which gives the result. It has in fact been observed that it is possible to induce stenosis even on a healthy bronchus. Spontaneous occlusion may take place quite near to the cavity, and so far on the periphery that the stenosis eludes the range of the bronchoscope.

It has also happened in our cases that the occlusion was not complete, but both freedom from bacilli has been obtained and the cavity was no longer visible. As was stated above, it has also been found that an atelectasis may arise without the bronchus being completely closed. A similar cause may also explain that finding, i. e. diminished but not quite blocked air supply.

It has already been shown before in connection with the treatment of tuberculosis of the bronchial mucous membrane that in a great number of cases galvano-cautery produces bronchostenosis. The only case in which stenosis was attempted by means of silver nitrate solution failed as far as occlusion was concerned. This was the case in spite of the fact that a 50 % solution was used which according to Adams should produce necrosis. Skoog's investigations, too, support the assumption that for purposes of occlusion silver nitrate solution should not be used.

A certain caution must be used in judging the results of occlu-

sion treatment, because it has been shown that the cavernous bronchus may close spontaneously and the cavity heal. Until it is known with certainty that occlusion of the cavernous bronchus is the key to the healing of the cavity, this treatment should be judged by its value and be considered to be in the experimental stage for the present. Cases must be carefully selected. Heavily impressed patients have not usually responded to the treatment.

h. Aspiration treatment.

Attempts have been made by aspiration to bring about the collapse of the cavity, and in this way to remove stagnant secretion. Pulmonary abscesses have been treated by this method, and it has been desired to transfer this treatment to tuberculous cavities. Hansen and Schmidt point out that in the treatment of pulmonary abscesses it is only possible to reach the abscess itself with bronchoscopic aspiration in a very small number of cases, and yet it is possible to see the effect of the treatment. They think that the bronchoscopy sets in motion a stream of secretion, and in this way the abscess empties itself after a vicious circle has been broken. The authors also point out that we may suppose that by the aspiration plugs of secretion or other obstructions are removed from the abscess bronchus, and in this way the emptying of the abscess itself is facilitated in a purely mechanical way.

An attempt has been made to transfer this method of procedure to the treatment of pulmonary tuberculosis when it is a question of producing collapse of a cavity which defies the normal treatment. Thus Bari  ty, Paillas and K  rambrun report a case of rapid collapse of a cavity after 3 aspiration treatments in the cavernous bronchus. Meyersburg, Gruber and Lupo also describe 3 cases of cavernous pulmonary tuberculosis in which collapse of the cavities was not obtained in spite of satisfactory collapse treatment, but which healed after aspiration through the bronchoscope. It is probable that there was some obstruction to the collapse. In all three cases there was an oedema of the cavernous bronchus which clearly constituted an obstacle to the emptying of the cavity. Lemoine reports the healing of 5 out of 6 pressure cavities after aspiration through the bronchoscope. They healed in a collapsed lung without adhesions.

The aspiration procedure has also been used as a method of treatment in other kinds of stagnation of secretion in the treatment of pulmonary tuberculosis. In the case of stagnation behind a stenosis in a bronchus, this treatment has been used, especially as a preoperative measure before thoracoplasty, lobectomy or pneumectomy. Tuttle points out that cases of stenosis should be operated, but that before the operation bronchoscopy should be performed with careful aspiration of the bronchial tree, so that stagnation of the secretion is avoided as far as possible on the days immediately following the operation; it may also possibly be necessary to carry it out after the operation in order to avoid the toxic effects of the stagnation.

Another complication which is not, however, quite linked to pulmonary tuberculosis but which may occur in confined patients with other diseases of the lungs; it is pseudo-membranous tracheobronchitis. The membranes may become detached and choke the patient. Jacob, Cans and Langle describe such a case of pseudo-membranous tracheobronchitis in a confined tubercular patient. On the attack of choking, the patient was examined with the bronchoscope and the membrane sucked up. Within twenty four hours, however, there was a relapse and the patient choked. Bronchoscopy was not performed again on the relapse. The authors maintain that this complication is rare, but as a rule it requires bronchoscopic treatment.

My own investigations.

For aspiration treatment through the bronchoscope, partly cases of pressure cavities or other cases of cavities which did not improve with other treatment, partly cases of bronchostenosis with stagnation of the secretion, and partly cases with other kinds of difficulties in the voiding of secretion (1 pseudo-membranous tracheobronchitis, 1 case of bronchiectasis and 1 case of pulmonary abscess, not of the tubercular kind) have been sent up for examination. A short report of the cases follows.

Treatment of pressure cavities:

Case 24. Woman, 24 years. Bilateral pulmonary tuberculosis with pressure cavity on the right side. Obstruction of the phrenicus was performed. On bronchoscopy, stenosis of the cavernous bronchus was observed. Aspiration was carried out, and this produced a temporary subjective alleviation. Because

of a deteriorated general condition, further treatment was considered unsuitable. The cavity did not diminish.

Case 63. Man, 37 years. Pressure cavity at left apex. No bronchial changes were shown on bronchoscopic examination. Aspiration carried out twice, but with no effect on the cavity. Two years later also a pressure cavity on the right side. On this occasion, this showed no bronchial changes. Aspiration on this side too without effect on the cavity. Treatment broken off on account of deterioration in general condition.

Case 80. Man, 29 years. Cavernous pulmonary tuberculosis with increasing cavity at the right apex. Pneumothorax had not effect. Obstruction of the phrenicus did not diminish the cavity. On bronchoscopic examination, specific bronchitis in the cavernous bronchus with marked stenosis was observed. Treatment carried out with silver nitrate cautery and aspiration. The cavity did not diminish, so pneumothorax was given up and Monaldi drainage tried. Death 8 months later.

Case 126. Woman, 26 years. Pulmonary tuberculosis with cavity at left apex, which increased after pneumothorax. No stenosis and no certain bronchial changes could be shown. Aspiration carried out on three different occasions. The cavity diminished somewhat but did not quite disappear. (Pneumothorax treatment relinquished before the aspiration.)

Case 143. Man, 33 years. Left-sided pulmonary tuberculosis with cavity which increased in size after pneumothorax probably on account of valve mechanism. The cavernous bronchus showed no specific changes at bronchoscopy. Aspiration carried out, but the cavity showed no signs of healing.

Case 162. Woman, 27 years. Pneumothorax carried out on right-sided cavity which increased in size probably on account of valve mechanism. On bronchoscopic examination, no specific changes nor any stenosis either could be observed. Aspiration performed. The cavity continued to increase in spite of the aspiration.

Case 214. Woman, 36 years. Pulmonary tuberculosis with bilateral apex cavities of the pressure type. Pneumothorax on the left side with negative results, not carried out on the right side. Monaldi drainage on the left side. On bronchoscopic examination, no certain specific changes could be observed. Cautery performed to obtain occlusion. Bilateral aspiration. The left cavity diminished little by little (Monaldi drainage), but the right one remained unchanged in spite of further aspiration. Death 6 months later.

Case 259. Woman 21 years. Bilateral cavernous phthisis with a pressure cavity at the top of the right lower lobe after pneumothorax. On bronchoscopy, a specific bronchitis with stenosis in the lower lobe bronchus was seen, especially in the first dorsal branch bronchus. The specific bronchitis was treated with silver nitrate solution. The cavity increased at first, but after three further aspirations it diminished but did not disappear. Total atelectasis produced in the lower lobe. Death 3 years later.

Case 291. Man, 34 years. Pulmonary tuberculosis with giant cavity of the pressure type at the right apex. Monaldi drainage. The cavity diminished, but did not disappear. Aspiration via the bronchoscope was then tried, and later occlusion cautery. A number of treatments, both aspirations and cauteries, were carried out but no durable healing of the cavity was produced. Thoracoplasty was done later.

Case 309. Woman, 22 years. Bilateral pulmonary tuberculosis with double-sided pneumothorax, and suspected specific bronchitis in the right upper lobe. Since the cavity did not collapse, cautery was performed on the right apex after which a pressure cavity appeared there. No valve formation could be seen at bronchoscopy. Aspiration carried out and repeated without any decrease of the cavity being observed after the treatments. After treatment with PAS, however, improvement (simultaneous tuberculosis of the intestine).

Case 354. Woman, 23 years. Pulmonary tuberculosis which healed after pneumothorax. However, there was a relapse with a giant cavity of the pressure

type on the left apex. Nothing pathological could be found on bronchoscopy. Aspiration performed. The cavity increased very quickly after aspiration. Later PAS treatment was started and improvement set in.

Eleven cases of pressure cavity were treated with aspiration of the cavernous bronchus. In no case could any diminishing effect on the cavity be observed (100% failures). It was not possible to reach the pressure cavities with this aspiration treatment which consisted in inserting an aspiration tube in the cavernous bronchus via the bronchoscope. Even in those cases in which stenosis of the cavernous bronchus could be observed and in which it was possible to insert the tube through the stenosis the treatment failed. In order for a pressure cavity to be produced, there must be valve obstruction. This obstruction may lie very far on the periphery, probably as far as the cavity wall itself, and it is thereby inaccessible to the aspiration treatment. The obstruction in the cases we have described could hardly have been composed of cheese-like masses or secretion, because in that case they would be susceptible to aspiration treatment, but they probably consisted of scarred stenoses.

Cavities not of the pressure type:

Case 4. Man, 18 years. Pulmonary tuberculosis with cavity in the right lower lobe. Pneumothorax could not close the cavity so it was relinquished. The cavity did not close after obstruction of the phrenicus either. Bronchoscopy showed normal conditions. The cavernous bronchus could not be localised. Aspiration performed without any effect on the cavity.

Case 41. Man, 24 years. Left-sided apex cavity. Did not collapse after pneumothorax. Bronchoscopy showed normal conditions. Aspiration carried out on two different occasions, and decrease of the cavity was obtained, but it did not quite disappear.

Case 116. Woman, 51 years. Right-sided pulmonary tuberculosis with atelectasis in upper lobe and large cavity of possible pressure type, probably valve mechanism. On bronchoscopy examination, a tuberculous bronchitis was observed in the upper lobe bronchus with stenosis of the cavernous bronchus. Aspiration carried out on two different occasions; the cavity diminished but did not disappear.

Case 186. Man, 21 years. Pulmonary tuberculosis with cavity the size of an orange at the top of the lower lobe, possibly of the pressure type. Bronchoscopy showed the first dorsal branch bronchus in the lower lobe swollen, red and constricted. Aspiration carried out. No effect on the cavity after aspiration. After obstruction of the phrenicus the cavity rapidly regressed.

Case 230. Woman, 37 years. Pulmonary tuberculosis with cavities on both sides. Bilateral pneumothorax with good effect on the right side, but no effect on the left side. Bronchoscopy showed no specific changes. Aspiration carried out. On the left side there were multiple cavities and 2 of them diminished, but the third was not affected at all.

Case 237. Man, 28 years. Cavernous pulmonary tuberculosis on the right side.

Good collapse with pneumothorax, but not of the cavity. On bronchoscopy, an unspecific bronchial change was observed but no stenosis. Aspiration performed and the cavity disappeared after one month. Atelectasis was, however, present in the lobe with the cavity.

Case 251. Man. 35 years. Old, bilateral, cavernous pulmonary tuberculosis with healing of the left cavity after Monaldi drainage and apex plasty. The right-sided one increased. No specific changes could be seen on bronchoscopy. Aspiration carried out. The cavity diminished, but did not disappear. Occlusion treatment begun but no stenosis obtained. Aspiration performed 4 times. The cavity disappeared, but freedom from bacilli was not obtained.

Seven cases of cavities were treated by aspiration of the cavernous bronchus through the bronchoscope. Two of the cavities may have been of the pressure type. The cavities had not receded with pneumothorax, obstruction of the phrenicus or conservative treatment. In 3 of the cases no effect at all was produced by aspiration treatment, in 2 cases, however, the cavities diminished. In one case it was carried out in connection with silver nitrate cautery of tuberculosis of the bronchial mucous membrane in the cavernous bronchus, in the other in conjunction with pneumothorax treatment. In two cases the cavity healed relatively quickly, in one case with an atelectasis in the other with an attempt to produce stenosis by cautery. From these cases we may come to the conclusion that aspiration treatment has a certain contributory effect on the healing of cavities, but no independent one. The cause of no effect being obtained by aspiration of the cavernous bronchus may to a certain degree be that it is not possible to obtain strong enough aspiration of the cavity itself so that the capsule, which is often relatively firmly fixed, collapses. Before the capsule collapses, there is certainly a collapse of the bronchial wall, and in this way the whole effect of the aspiration on the cavity itself is excluded. If it was possible to insert the tubes into the cavity itself, the aspiration would be greater, and the effect certainly better. Perhaps this is possible in very rare cases. In our cases, however, it has not been possible.

Stagnation of secretion behind bronchostenoses:

Case 37. Woman. 28 years. Progressive tuberculosis of the main bronchial mucous membrane with stenosis, which on repeated occasions was treated with dilations and aspiration of the stagnant secretion. After the aspirations, the cough diminished temporarily as well as the secretion. Relapses, however, occurred regularly. Finally, total atelectasis of the lung was obtained.

Case 140. Woman. 20 years. Bronchitis trouble and slight roentgenological parenchyma changes in the lungs. On bronchoscopic examination, stenosis of the upper lobe on the right side and suspected tuberculosis of the bronchial

mucous membrane was observed. Later tubercular bacilli were again present. Difficulties were also present with stagnation of the secretion on the left side. No alleviation was obtained, but instead the bronchial trouble increased. Death 6 months later.

Case 370. Woman, 15 years. Tuberculosis of the bronchial mucous membrane in the left main bronchus with stenosis. This was clinically interpreted as a gland perforation. Atelectasis obtained in the upper lobe. Because of difficulties with stagnation of secretion, aspiration of the bronchial tree was recommended. Treatment was carried out several times, partly with silver nitrate cautery on the changes in the mucous membrane, and partly with aspiration. The atelectasis did not resolve itself, but the stenosis regressed. The specific changes regressed and healed completely.

Case 413. Woman, 41 years. Old pulmonary tuberculosis which clinically showed a tendency to heal. On bronchoscopic examination, it showed itself, however, to be tuberculosis of the bronchial mucous membrane in the left main bronchus. During treatment of the bronchial changes, stenosis of the main bronchus was produced and atelectasis in the lower lobe and signs of secretion stagnation. Temporary improvement after aspiration treatment. Later thoracoplasty.

Four cases of secretion stagnation behind a bronchial stenosis were treated by aspiration of the secretion. In 3 of the cases alleviation was obtained after treatment, and even healing after healing of the specific process in one case. In the fourth case, the condition deteriorated in spite of aspiration.

Non-tuberculous cases:

Case 29. Woman, 30 years. Lung trouble for examination at the sanatorium. Operated on for bronchiectasis (lobectomy) on the right side. Entered sanatorium for aspiration of the bronchial tree on account of stagnation of the secretion. After aspiration there was immediately considerable alleviation.

Case 266. Man, 44 years. Aspiration pneumonia after tooth extraction under narcosis. Hemoptysis 3 weeks later, so the patient came to the sanatorium for examination. An abscess of the lung was observed and aspiration recommended. This was carried out via the bronchoscope. The bronchitis increased, however, as did the quantity of secretion. Operation later.

These two isolated cases only show that occasionally cases not of a tuberculous kind come into a department for pulmonary tuberculosis for examination and partly for treatment, and for this reason they must be bronchoscopically examined and treated.

Pseudo-membranous tracheobronchitis:

Case 40. Woman, 30 years. Pulmonary tuberculosis with tuberculosis of the bronchial mucous membrane in the main bronchus; stenosis little by little. In an acute infection, the patient acquired one of those rare complications which are not only known in cases of pulmonary tuberculosis, but also in other confined patients with affections of the lung, a pseudo-membranous tracheobronchitis which threatened to choke the patient. Bronchoscopy was performed on vital indications with cleaning up of the air passages clear of the mem-

branes. After 2 days bronchoscopy was undertaken again with new aspiration of the secretion and membranes after which the hindrance to breathing was removed.

This last quoted case shows that sometimes there are vital indications for bronchoscopy in sanatorium material.

Discussion: Different authors have described the treatment of pulmonary abscesses by means of aspiration treatment via the bronchoscope. Since then this treatment has been transferred to the treatment of pressure cavities and large cavities which did not regress under the normal methods of treatment. Lemoine has even described 5 successful cases of pressure cavity, out of 6 treated, which healed with aspiration treatment via the bronchoscope. In our material, 11 cases of pressure cavity were treated in this way without any noticeable decrease in the cavity being observed. The cause of this lack of success has not been able to be established with certainty. Probably the circumstances were that the cavities were not accessible to this form of treatment on account of such marked valve formation that the valve could not be passed by the suction action.

Also in the treatment of large cavities, not of the pressure type, the results have not been especially good. Of 7 cases, only 2 cavities healed, 1 with atelectasis and 1 after occlusion treatment. In neither case, therefore, can it be said that aspiration was the decisive factor.

The treatment has, however, great importance because it diminishes the subjective trouble which the patient suffers from on account of the abundant collection of secretion in the bronchi. The latter is even more important when it is a question of cases of stagnant secretion behind a bronchostenosis.

In the rare cases of pseudo-membranous tracheobronchitis, the treatment is sometimes life-saving, as the case described by us shows.

i. Secretion tests.

A number of authors give undecided bacilli findings as an indication for bronchoscopy. In order to be able to decide which side it is that provides the bacilli, a secretion test must be taken. It may also be desired to obtain concentrated secretion from a cavernous bronchus or from a certain part of the lung. In these

cases, too, bronchoscopy must be carried out. Quite early, Lemoine and Diacoumopoulos maintained the importance of this. These authors have, however, made a report of 36 cases of open tuberculosis where the test sputum previously contained tubercular bacilli, and where on aspiration via the bronchoscope and examination of the secretion, 17 cases were negative for tuberculosis. They came to the conclusion that the bacilli were not delivered continuously from the cavities. McIndoe and his helpers observed the same thing. In an investigation of 136 cases with negative sputum test, 19 had tubercular bacilli in tests taken at bronchoscopic examination, and in 136 cases with a positive sputum test, 10 had no tubercular bacilli in tests taken during bronchoscopy.

Shipman also maintains the great importance of secretion tests taken under bronchoscopy in the diagnosis of the side, and also to obtain samples of concentrated secretion. Leegaard also points out the importance of secretion tests, and mentions cases in which he succeeded in demonstrating tubercular bacilli in smears from the bronchial secretion, while cultures and tests from rinsing liquid from the ventricle had been negative.

My own investigations.

The interest in secretion tests has to a very great degree been concentrated on the question with what certainty can the examination give a decision as to positive or negative bacillus finding which corresponds to the real conditions. A negative answer may be a coincidence, depending on the fact that the bacilli are not delivered continuously, as is maintained by Lemoine and Diacoumopoulos. A positive test from the apparently healthy side may depend on the fact that secretion from the diseased side has come over to the healthy side, either having flowed over directly or having been sucked down, or also having been transferred by the bronchoscope during the examination. It is, however, possible to get a decision with a certain degree of probability which can be used in planning further treatment. Repeated tests giving the same results increase the certainty that the outcome of the test corresponds to the reality.

The taking of tests has been performed in the following manner: the bronchoscope is first taken down to the carina, and then

all the accessible secretion is sucked clean. Then the bronchoscope is directed into the suspected healthy side whereupon with a new tube aspiration of secretion is made which is collected in a container. Thereafter the bronchoscope is inserted into the other side and with a third tube aspiration of secretion is made which is collected in another container. The preparation is then examined directly in the microscope after staining, a culture and guinea-pig test being made afterwards. In isolated cases, where there has been no success in obtaining secretion by aspiration, rinsing has been carried out with a sterile solution of cooking salt in a flexible tube up in the bronchus from which a test was desired, and this has been sucked up as it came out. In only one case has it not been possible to obtain any secretion at all. There is no absolute guarantee that this method of procedure excludes all errors, but it permits in each case as great certainty as the conditions in the bronchial tree allow.

In 54 cases the question asked was: "From which side do the bacilli proceed?" The answer has been:

in 32 cases unilateral

in 22 cases bilateral.

In 4 cases a test was only taken from one side, and in all of these cases it was positive. In one case, as was mentioned above, no secretion at all could be obtained.

In 18 cases the bacilli findings were negative in the coughed-up secretion, but positive in that obtained by aspiration. In 24 cases both the coughed-up and the aspirated secretion was negative. As a rule this latter examination was undertaken as a safety measure in controlling clinically healed cases of tuberculosis, or in uncertain cases.

In 5 cases the coughed-up secretion was positive, but that which was aspirated was negative. This constitutes a parallel to the results of their investigations announced by Lemoine and Dia-coumopoulos. In one of the said cases, however, only one test was positive of the coughed-up secretion and a culture was not made, so it must be taken with a certain qualification.

Discussion: Secretion tests are, as has been pointed out in several places, of the greatest importance. It is one of the weightiest undertakings in bronchoscopy for pulmonary tuberculosis. Judgment must always be passed critically. The clinician must be

well acquainted with the sources of error which, however, may be reduced by repeated tests giving the same results. Most of them should be aware that secretion may flow over from one side to the other, thus making the test positive. But it should also be realised that bacilli are not excreted continuously. A negative test is therefore not decisive.

The advantage of bronchoscopic aspiration of secretion for tests is that the secretion is obtained in concentrated form from just the diseased bronchus or from the bronchus suspected of being diseased. The secretion is thus less diluted with saliva or with secretion from other parts of the bronchial tree.

j. Other indications for bronchoscopy in pulmonary tuberculosis.

Besides the indications laid down, in isolated cases other indications for bronchoscopy may be present. The lung specialist may ask a special question, he may make an attempt at treatment or also he may desire bronchoscopy as a means of control.

My own investigations.

Bronchial fistulas to the pleura:

In a number of cases bronchial fistulas to the pleura after a plasty, sealing or other operation have been discussed. The question has been whether there were any changes present in the bronchus leading to the fistula, or there has also been a desire to attempt to obtain occlusion of this bronchus. Here follows a short report of the cases.

Case 15. Man. 21 years. After primary tuberculosis 3 years before the operation, the patient had long drawn-out "symptoms of cold". Haemorrhages supervened. Hydropneumothorax was observed and the air was not reabsorbed, so that communication with the bronchi was suspected. Bronchoscopy showed marked suspected specific changes in the left lower lobe which were treated with silver nitrate solution. The changes in the lung then rapidly receded as did the hydropneumothorax.

Case 188. Man. 29 years. Old pulmonary tuberculosis with thoracoplasty and a bronchial fistula in the scar. At the first bronchoscopic examination the findings were negative, but later there were suspicions of tuberculosis of the bronchial mucous membrane. Revision of the thoracoplasty was carried out and both the fistula and the suspected changes in the cavernous bronchus healed.

Case 274. Woman. 33 years. Old pulmonary tuberculosis and later oleothorax. 2 years later penetration of the oil to the fistula in the scar. It was observed that the fistula also had communication with the bronchial tree. An attempt at occlusion was carried out on the bronchus leading to the fistula. On

bronchoscopic examination there was seen to be a suspected specific change in this bronchus. Cautery was performed without obtaining occlusion.
Case 325. Man. 32 years. Old pulmonary tuberculosis with pneumothorax and empyema. The empyema healed, but later a bronchial fistula to the empyema cavity appeared. Bronchoscopy showed negative findings.

The investigation allows no conclusions to be drawn from it, partly on account of the smallness of the material, and partly because it is so heterogeneous. It only provides an illustration of what was said above, that bronchoscopy is sometimes used outside the ordinary range of indications.

Control bronchoscopy:

A certain group of bronchoscopic examinations have reference to control examinations. It sometimes is a question of the control of a finding of which the certainty was not positive at a previous bronchoscopic examination, or it may also be a control of treatment and the course of a specific process.

Controls have specially often been carried out in our material in cases of treatment of tuberculosis of the bronchial mucous membrane with streptomycin or PAS. It has in fact happened that patients have been free from bacilli, and also the lung process has appeared to have cleared up. But on control bronchoscopy, it has nevertheless been shown that the bronchial tuberculosis was still open. From these findings it has been possible to explain that, as not so seldom happens, a patient treated by these means becomes negative for bacilli, and that this is as far as the means go; but some time after the end of the cure, they again become positive for bacilli. The ulcerations in the bronchi have as a matter of fact never been healed.

The control of any eventual progression in a specific process of the bronchi is especially important, especially when accompanied by stenosis. It is in fact of great importance that the right treatment of a stenosis lung should be begun at the proper stage, before complications have occurred.

The control of a finding which is not quite certain should obviously be carried out. Even if a negative result was obtained to a test excision, in many cases control bronchoscopy must be carried out, and a new test excision made.

Control bronchoscopy forms an important group, and in our material comprised 100 cases.

k. Differential diagnostic questions.

As has already been said in the foreword, in a special hospital for tuberculosis, many cases come in to be examined for diseases of the lungs which sometimes prove to be of tuberculous nature and in other cases are non-tuberculous. Thus Mastbaum and Troutnev talk of lung cases which were first explained after bronchoscopic examination. Rimér describes 3 cases of tuberculosis in the lungs which were very difficult to diagnose. One of them was cleared up after a test excision via the bronchoscope, but the two others only after thoracotomy and test excision. Rosenqvist maintains that by means of bronchoscopy a diagnosis of tuberculosis may be refuted where clinical and roentgenological examinations give no sure grounds, for example in the case of a haemorrhage. Lecceur and Mathey speak of cases of obscure lung diseases in which it was impossible to decide if it was a case of tuberculosis, tumour or other disease of the lung. On bronchoscopic examination it was shown, after a test excision, to be tuberculous. Vanduffel describes similar differential diagnostic questions, which were cleared up by means of bronchoscopy.

Besides the question of tumours, which is always present in cases of atelectasis, Schaumann's disease, lymphogranuloma benignum, takes an important place in these bronchoscopic examinations for differential diagnoses. Ryenaud published in 1948 the fact that Schaumann's lymphogranuloma benignum is less commonly localised in the larynx, and rarely localised in the trachea or bronchi. Opsahl has described a case of a tumour with stenosis in the opening to the right main bronchus in a 60 year old woman patient. After a test excision, this proved to be benignant tuberculosis, but interpreted by Opsahl himself as Schaumann's disease. Lindvall also quotes a case of Schaumann's disease which was observed on bronchoscopic examination. A thickening of the mucous membrane was found by the carina and a test excision was made. Pathologically and anatomically it showed itself to be Schaumann's disease.

Another group of these investigations comprises patients with asthmatic symptoms. It is known that bronchial tuberculosis, and especially stenoses in the bronchi, produce symptoms which are to a high degree like the symptoms of ordinary bronchial asthma.

Werner describes a case of tuberculosis with asthmatic symptoms, which on bronchoscopic examination proved to be dependent on tuberculosis of the tracheal mucous membrane. Carstensen was even able to show eosinophiles in the blood of these patients with asthmatic symptoms. A number of patients with such symptoms were therefore sent up for examination.

An important group from a differential diagnosis point of view, especially important for the patient, is the question whether eosinophile infiltration is present in the lung, or if it is tuberculosis. Such cases, too, are included in our investigations.

Finally, there are included bronchial affections of a banal type such as chronic bronchitis with or without bronchiectasis, pulmonary abscesses and such like.

My own investigations.

Questions of tumour.

In many cases it may be difficult for the clinician to decide whether tuberculosis or a tumour is present. In our material the question of tumour or other bronchial affection arose in 38 cases, and cancer was observed in 6 cases. In one of the cases, a test excision was made which proved negative for tumour. Since, however, suspicions of cancer were so marked, a new bronchoscopic examination was made and a new test excision which showed a bronchial cancer. In one case (No 208) the question was whether there was a tumour. There was an enlargement of the hilus without parenchyma changes. No tubercular bacilli had been shown. Bronchoscopy showed, however, after a test excision that it was bronchial tuberculosis. In 31 cases where it was suspected that there was a tumour present, the bronchoscopic findings were negative or the test excision gave a negative answer. In none of these cases did their further course show that a tumour was present. In one of the cases, however, a pleural tumour appeared little by little and this had not proceeded from the bronchi or parenchyma.

In doubtful cases, or in cases which are under observation for possible tumour, bronchoscopy with complementary test excision is an invaluable help. It is of the greatest importance to distinguish cases of tuberculosis from those of tumour.

Lymphogranuloma benignum, Schaumann's disease.

In our material there were 4 cases of lymphogranuloma Schaumann. In all the cases the bronchoscopic findings were negative with regard to the suspected changes, and an examination of an extirpated tonsil gave the answer. In one case, however, there were changes on the epiglottis which also under microscopic examination showed themselves to be of the same kind.

Asthmatic symptoms.

Eleven patients had been sent in for examination on account of asthmatic symptoms. In 4 cases the results of bronchoscopy were quite negative. Of the 7 positive cases, 2 were of progressive tuberculosis of the bronchial mucous membrane with stenosis, 3 were bronchostenosis without any specific infection present, and the 2 remaining cases were diffuse bronchitis without specific signs.

Nowadays it has become fairly general for bronchoscopy to be carried out as a matter of routine on asthma patients. Our investigation shows that this examination should be kept in mind to a specially high degree when a patient with pulmonary tuberculosis has asthmatic symptoms.

Eosinophile lung infiltration.

In Differential diagnosis against tuberculosis, eosinophile infiltration of the lung plays a certain part. 2 such cases were examined bronchoscopically. In both cases the bronchoscopic findings were negative, but in one case a test excision was made of the mucous membrane in one main bronchus. The preparation showed abundant infiltration of eosinophile cells in the mucous membrane. The blood eosinophile in this patient was between 30 and 50 %. The test excision thus supported the clinical diagnosis.

Non-specific bronchial affections.

Bronchiectasis and chronic, non-specific bronchitis cases are sometimes received at a sanatorium for observation for the exclusion of a diagnosis of tuberculosis. 5 cases of bronchiectasis were examined with the bronchoscope, in 3 cases with entirely negative results, in the 2 others there was only a non-specific bronchitis picture. 3 cases of chronic bronchitis showed in addition to the chronic picture an unimportant non-specific bronchitis. 3 cases of pulmonary abscess and one of infected pulmonary cyst were examined bronchoscopically for differential diagnosis purposes and were treated by aspiration in this connection.

The above shows that with tuberculous material it is always necessary to count on differential diagnosis bronchoscopic examinations which may show themselves to be non-tuberculous. It is of special importance to distinguish between cases of tumour and cases of tuberculosis.

It has also been found that in many cases asthmatic symptoms in pulmonary tuberculosis give a positive bronchoscopic finding, either in the form of a tuberculous affection of the mucous membrane, or of bronchostenosis, sometimes both together.

1. Routine bronchoscopy before carrying out artificial pneumothorax, before thoracoplasty, or before lobectomy or pulmectomy.

It is known that in a certain number of cases an acute atelectasis is produced in the lung or in a part of it when artificial pneumothorax is carried out. The danger of such an atelectasis in the treatment of pulmonary tuberculosis has already previously been touched on. Bronchostenosis has been considered to be to a great degree to blame for these atelectases. It is in order to obviate such surprises in the form of acute atelectasis that routine bronchoscopy before carrying out a pneumothorax has come to the fore. Bunner, for example, considers that in cases of bronchostenosis, great restraint should be observed with every form of collapse therapy, both artificial pneumothorax and obstruction of the phrenicus, because it may lead to an irreparable atelectasis. Baron emphasizes the great importance of bronchoscopy being carried out before a pneumothorax is made, since by these means the occurrence of an acute atelectasis with its unwelcome complications can be avoided.

Rafferty and Shields state that 43 % of the patients treated by pneumothorax suffered an atelectasis. Complications in the form of anaerobe infections, tuberculous empyema and non-re-expansion were common in carrying out pneumothorax. These authors also point out that reexpansion was impossible in most cases of atelectasis after pneumothorax. In cases of extensive ulcerous, tuberculous bronchitis or partial stenosis, the prognosis is so bad that a pneumothorax is contraindicated in these cases. The danger is so great, that everything possible must be done before carrying out the pneumothorax to exclude these bronchio-

genic complications. The danger is especially great when the bronchiogenic complication is in the acute stage. Thoracoplasty does not produce these dangerous complications. It is therefore necessary to make a bronchoscopic examination before these interventions. Hawkins Jr. does not consider that tuberculosis in the greater bronchi or in the trachea is a contraindication to collapse therapy or major surgical operations on the lung.

Brantigan, Hoffman and Proctor state that the increased use of bronchoscopy in pulmonary tuberculosis has shown that an important percentage of bronchial damage exists. They show the importance of this bronchial damage to the course taken by a lung treated by pneumothorax. With a relative obstruction in the cavernous bronchus it is possible to obtain the rapid re-expansion of the lung after carrying out pneumothorax. In the case of greater obstructions or stenosis, there is a risk of kink formation in the cavernous bronchus completely shutting it off and thereby producing atelectasis in the lung. It has already been shown that this atelectasis does not so often resolve itself. They maintain, therefore, that pneumothorax treatment should not be embarked upon without a purely routine bronchoscopic examination first in order to exclude the possibility of the existence of tuberculosis of the bronchial mucous membrane or stenosis. One can, however, not be absolutely certain in spite of these precautions, because the changes may sometimes lie so far on the periphery as to be out of range of the bronchoscope.

Rischel points out that bronchoscopy should be carried out before a pneumothorax is made when there is any suspicion of the presence of tuberculosis of the bronchial mucous membrane. Small ulcerations and early lesions without stenosis are without importance. Extensive ulcerative processes in a greater bronchus, or extensive affection with stenosis are contraindications to pneumothorax. They are often accompanied by an atelectasis, when it has been shown that the bronchus may be entirely blocked. Re-expansion may also be rendered impossible even if there has been no question of complete blocking of a greater bronchus.

The dangers of atelectasis have also been pointed out from other sources. Schubert¹¹ states that rapid atelectases have been seen to develop in carrying out pneumothorax, and this probably depends on a kink formation in the bronchi, which in its turn

depends on a bunching of the lung itself. This may also occur during obstruction of the phrenicus, and more seldom during thoracoplasty. Alexander also talks of acute atelectasis in connection with the carrying out of pneumothorax, after which the lung does not reexpand but becomes hardened. In worse cases, there may be secondary infection and the formation of abscesses. This may depend on a cross kink in the cavernous bronchus during the carrying out of the pneumothorax. The mechanism itself causing the occurrence of blocking of the bronchus will be discussed further. Thus Lloyd and Budetti consider that in pneumothorax kinking of the bronchus does not take place with its consequent total obstruction, but that on the contrary the bronchus falls, and especially the upper lobe bronchus, parallel with the main bronchus, and that this allows a very fine view into the upper lobe bronchus in bronchoscopy. On the other hand, in thoracoplasty, there may be kinking and obstruction of the bronchus. Kinking and obstruction may occur in pneumothorax on cases with adhesions.

Farber has made the suggestion that if there is an occlusion of the cavernous bronchus and a pneumothorax is performed, an atelectasis arises and then the lung does not reexpand when the pneumothorax is relinquished. This may also occur in tuberculosis of the bronchial mucous membrane. He describes two cases of pneumothorax with such complications. In conclusion he says that bronchial lesions form a deciding factor in the pathogenesis of a lung which does not reexpand.

Sharp and Gorham maintain that bronchoscopy is a harmless operation which should as a rule be carried out before every major operation on the lungs. It should further be carried out before every form of collapse treatment (artificial pneumothorax, obstruction of the phrenicus, pneumoperitoneum). It should be performed in order to exclude bronchial affections and such like, since they are contraindications to collapse treatment. Bronchoscopy, carried out as a matter of routine, enables these lesions to be discovered and treated at an early stage. Lefèvre and Logivière consider tuberculosis of the bronchial mucous membrane to be resistant to collapse therapy. Secrétan and Zuidema, however, consider that tuberculosis of the bronchial mucous membrane is not a contraindication to the performing of pneu-

mothorax. Dumarest, Tacon and Varin describe several cases of atelectasis depending on bronchial stenosis.

Tuttle and O'Brien publish the result of pneumothorax treatment in 47 patients with bronchial stenosis:

Tuberculous empyema	15	31.9 %
Unexpanded lung	22	46.7 %
Pneumothorax given up	14	29.7 %
Pneumothorax adequate	12	25.5 %
Bronchial fistula	2	4.2 %

13 patients treated with pneumothorax of those with bronchial stenosis died. Thoracoplasty gave better results.

Aufses describes 2 cases of bronchostenosis in which complication occurred in all attempts at collapse therapy. This does not only apply to pneumothorax, but the danger exists also with thoracoplasty.

With regard to routine bronchoscopy before a thoracoplasty operation, Bunner considers that a major operation should not be carried out before the bronchial tuberculosis has healed. Only minor upper lobe atelectases which are favourably affected by apex plasty are not so dependent on the bronchial complications being healed. In order to make sure of this, bronchoscopy must be carried out before the operation. Crafoord advises bronchoscopy in every case of pulmonary tuberculosis before it is subjected to surgical treatment. Rischel also maintains that bronchoscopy should be carried out before every thoracoplasty operation. Myerson, in his indications for bronchoscopy, gives a routine bronchoscopic examination before every thoracoplasty operation.

My own investigations.

Our material, as far as routine bronchoscopy before a pneumothorax is concerned, comprises 24 cases. In 3 of the cases, we refrained from carrying out pneumothorax because of stenosis formation, and in one case pneumothorax treatment was carried out in spite of the presence of a relative stenosis (case 366). In this case no atelectasis occurred. The other 20 cases showed nega-

tive bronchoscopic findings. In none of these negative cases did atelectasis occur when pneumothorax was carried out later.

Phrenicus exheres, obstruction of the phrenicus and pneumoperitoneum are also forms of collapse treatment concerning which it has been suggested that bronchoscopy should be carried out as a matter of routine before the intervention. None of our cases came to us on these grounds.

In a number of cases atelectasis had occurred in carrying out pneumothorax or in connection with obstruction of the phrenicus. 21 such cases were sent for investigation. In the comparative table, a distinction has been made between those cases in which atelectasis appeared in immediate connection with the institution of collapse therapy, and those cases in which atelectasis was shown after a shorter or longer time — up to 2 years — naturally under the condition that the collapse therapy was being continued.

Atelectasis after	Stemosis.		Spec. or suspect. soec. bronchitis		Neg.	
	Total.	Part.	Total	Part.	Total.	Part.
Pneumothorax:						
Acute onset	1	—	2	—	2	1
Chronic	—	—	—	—	4	1
Obstr. of phren:						
Acute onset	—	—	—	—	—	—
Chronic	—	2	—	—	—	2
Pneumo: +						
Obstr. of phren:						
Acute onset	—	—	—	—	—	1
Chronic	—	—	—	1	—	1

Table 7.

In one case (no. 282), before carrying out pneumothorax there was an atelectasis which on bronchoscopic examination showed itself to be joined to stenosis and specific bronchitis in the main bronchus. Pneumothorax and obstruction of the phrenicus were carried out with good collapse of the lung. The process advanced and the patient died 8 months after the carrying out of the pneumothorax.

From the table it may be seen that of the cases of acute onset of atelectasis in connection with the carrying out of a pneumo-

thorax, 3 had bronchostenosis or specific bronchial changes which could be observed on bronchoscopy. We may say that in all probability these cases would not have been treated by pneumothorax if a routine bronchoscopic examination had been carried out before the operation. In cases of atelectasis running a chronic course, however, there have been no positive findings on bronchoscopic examination, and the question therefore arises as to whether there may possibly be some other cause for the atelectasis in these cases. No such other cause has, however, been shown bronchoscopically.

When undertaking obstruction of the phrenicus, in no case has there been an acute onset of atelectasis among the cases investigated. In this case, however, the material is so small that it allows no conclusions to be drawn from it. Possibly the danger of an atelectasis arising is less in obstruction of the phrenicus than in carrying out pneumothorax.

The combined treatment by pneumothorax and obstruction of the phrenicus shows only 3 cases, 2 with negative bronchoscopic findings and 1 with chronic onset of atelectasis and tuberculosis of the bronchial mucous membrane.

It would be a great gain if by means bronchoscopy it was possible with tolerable certainty to exclude those cases which, by reason of bronchial changes, are not suitable for collapse treatment by pneumothorax or obstruction of the phrenicus. By this means, many times it would be possible to save the patient years of treatment, since unsuccessful treatment often leads little by little to thoracoplasty or to lobectomy or even to pulmectomy. In a number of cases, we can already say with our present experience that these cases, by reason of bronchial stenosis or tuberculosis of the bronchial mucous membrane, are probably not likely to benefit by pneumothorax or obstruction of the phrenicus, but should be treated in some other way. The range of the bronchoscope is, however, limited and it is possible that a change may lie so far on the periphery that it cannot be seen. The cases may then produce a non-reversible atelectasis with its complications in spite of the negative bronchoscopic findings. As a rule, however, tuberculosis of the bronchial mucous membrane is not so limited that a centre situated right out on the periphery still presents a completely healthy view to the range of the bronchoscope. A certain security is therefore obtained by routine broncho-

scopy before pneumothorax and even before carrying out obstruction of the phrenicus. These latter cases showed, however, in our material, no complications with acute onset of atelectasis.

Routine bronchoscopy before a thoracoplastic operation was carried out in 19 cases. Of these, 9 gave negative bronchoscopic findings. 7 had specific bronchitis which in a number of cases was combined with bronchostenosis. 3 had stenosis of the bronchus, but without specific bronchitis being present. The specific changes were the object of treatment before the operation. In all the cases control bronchoscopy was carried out after the operation if specific changes had been present. In a number of cases the treatment was also continued after the operation.

Before a thoracoplasty operation, bronchoscopy should always be performed in order to diagnose possible tuberculosis of the bronchial mucous membrane. This may be the cause of the bacilli, and this is also true to the same degree of positive bacilli findings after the operation.

Bronchoscopy before lobectomy or pulmectomy is an absolute necessity, since the operator must be certain that there is a healthy bronchial stump so that it is possible to perform the operation. In our material there were 5 such bronchoscopic examinations. In one case the findings were negative, in 2 cases there was stenosis in a bronchus to one lobe but with a free stump in the main bronchus. In 2 cases there was tuberculosis of the bronchial mucous membrane present, of which only one had a healthy stump to the main bronchus.

Discussion: It is difficult for the bronchoscopist to judge how great is the importance of routine bronchoscopy before a pneumothorax and eventually before a thoracoplasty operation. However, the fairly coincident statements of different authors speak in favour of the great importance of this routine bronchoscopy.

The investigation has shown that a number of the pneumothorax operations, which either directly or later during pneumothorax treatment gave rise to an atelectasis, showed changes which could be seen through the bronchoscope and which explained the atelectasis. Probably a number of these pneumothorax operations would never have been performed if the patient had had the opportunity of being examined bronchoscopically before the operation. It has also been found that in none of the cases with

negative bronchoscopic findings on which pneumothorax was carried out did atelectasis occur.

It has been maintained by Crafoord and others that no major surgical operation on the lung should be undertaken without previous bronchoscopic examination. As regards thoracoplasty operations, this is of importance. It may in fact appear that a number of cases are better suited to pulmectomy or lobectomy rather than to simple plasty.

Before carrying out lobectomy or pulmectomy, a bronchoscopic examination is a necessity in order to decide whether there is a healthy stump available or not.

m. Test excisions.

In examining the bronchial tree via the bronchoscope, it may sometimes be difficult to decide with certainty to what category the changes observed belong. Berblinger, who on his material gives 4.85 % tuberculosis in the extra-pulmonary bronchi in cases of pulmonary tuberculosis, maintains that with microscopic examination of all the suspected cases the percentage would probably be higher.

In the elucidation of obscure lung cases, test excisions are of great value, as is maintained by Lecceur and Mathey. Opsahl has described cases which could not have been diagnosed without test excisions. In the same way Rimér mentions such cases. Samson, too, maintains the necessity for a test excision in cases where the differential diagnosis is tuberculosis — tumour.

My own investigations.

On account of the warning against complications in test excisions given by the lung specialist sending the case in, a special investigation has been made of the test excisions carried out in cases of pulmonary tuberculosis and in other cases which came up for elucidation.

Every test excision has its wrong side. A surface is wounded and lymph passages are opened. When it is a question of cases of bronchial tuberculosis, this means the possibility is offered for the disease process to spread further to its surroundings, and little by little to the other organs of the body via the blood stream. In the case of the air passages, dissemination by aspiration must

also be reckoned with. It is also possible through a test excision in a non-tuberculous region to produce a tuberculous infection through the bronchial secretion in the wound caused by the operation itself. Because of this theoretical point of view, a certain caution has been exercised concerning test excisions of the bronchi in tuberculous cases. It is, however, known, that a marked bronchogenous extension may occur in cases of pulmonary tuberculosis without a test excision or into the bargain without bronchoscopy being carried out.

In our material, test excisions were made in 33 cases, in which, however, in 6 cases there were 2 test excisions each, thus making a total of 39 test excisions. They are divided in the following way:

On account of suspected tuberculosis	
with positive answer	8
with negative answer	5
On account of suspected tumour	
with positive answer	6
with negative answer	9
On account of atelectasis	
with answer non-tuberculous	7
On account of eosinophile infiltration	
of the lung	1
Pulmonary abscess	2
Hemoptysis	1

In this connection, it is the cases with tuberculosis which present the greatest interest. Of the 8 positive cases, 6 had no complications at all. In 2 cases, bronchoscopy for control 1 month after the test excision showed noteworthy progression. In one case of negative finding for suspected bronchial tuberculosis, there arose in connection with the test excision and bronchoscopy a lingering, fluctuating fever which was interpreted as a bronchogenous extension of the tuberculous infection.

The subsequent course of the test excisions in all the other cases was quite free from complications.

Of the 13 tuberculous cases in which test excisions were undertaken, complications arose in connection with the test excision in 3 cases (23 %). Even if in tuberculous material generally these

complications may arise, the percentage figure is so high as to direct attention to the fact that there may be some danger. The material is not, however, so large that final conclusions can be drawn from it. Nor are there any reliable figures of the incidence of these complications in tuberculous patients in general. It is not possible either to obtain sure figures of this since pulmonary tuberculosis material is much too heterogeneous. In doubtful cases, the test excision should be made in spite of these complications. In cases without changes of the parenchyma, a test excision is an absolute necessity in order to get certain proof that tuberculosis is present.

Discussion: In an attempt to obtain some clarity as to whether a test excision in cases of tuberculosis of the bronchi constitutes a danger to the patient, a special investigation has been made into this operation.

Test excisions are of very great importance and cannot be dispensed with, especially in doubtful cases and cases where it is a question of differential diagnosis, in particular with regard to tumours. The greatest interest is concentrated on cases with positive findings of tuberculosis in the bronchi. Of 8 such test excisions which were made, an extension of the tuberculous process in the bronchi was noted in 2 cases. In one case of test excision with negative result as regards tuberculosis, there arose, however, a lingering, fluctuating fever which was interpreted as a bronchogenous extension of the pulmonary tuberculosis.

The experiences show that, in spite of the fact that the material is so small as to preclude the drawing of final conclusions, a certain restraint must be observed in the use of these test excisions.

CHAPTER VII

Post-bronchoscopic complications.

In the survey of the technique of bronchoscopy, purely technical complications were dealt with. The technical complications were partly those which arose during anaesthesia, and partly those which arose during the operation itself.

The third group of complications are those which arise in the course taken subsequent to bronchoscopy. To judge by the textbooks, these too have aroused the liveliest interest. One of the commonest complications of this kind is a greater or lesser rise in temperature after the operation. A desire has also been shown to make a distinction between so-called early and so-called late rise in temperature. Titcher sees the initial rise in temperature as being caused by the operation itself, and dependent on a certain degree of trauma. The later, or as he himself expresses it, the secondary rise in temperature would be the sign of the spread of the disease itself, or of an increase in its activity. Radner also makes a distinction between early and late rise in temperature. The "early" occurs immediately after the operation, and the later after a period of about a week's freedom from fever. In his material of pulmonary tuberculosis patients examined bronchoscopically, in 183 examinations on 97 patients, there were 18 cases of initial and 26 cases of secondary rise in temperature. Titcher's material of 245 bronchoscopic examinations on 147 patients had initial rise in temperature in about 42 %, and late rise in about 9 %. Smidt reports for 109 bronchoscopic examinations on 45 patients initial rise in temperature in 16.5 %, and secondary in 1 % of the cases. 2 cases of initial rise in temperature died after respectively 12 days and 3 weeks. Carlens gives 9.5 % fever complications for his cases of tuberculous material. Among the non-tuberculous patients in his material, the fever reaction did not occur so often.

Soulas maintains that there is a certain risk of spreading tuberculous infection by bronchoscopy. McIndoe and his helpers showed a rise in temperature in 32 cases (nearly 12 %) in a series of 272 bronchoscopic examinations on patients with pul-

monary tuberculosis. In this series they had progression of the tuberculous infection in 4 cases. Increase in the quantity of sputum also took place in a number of cases. Coates has shown, on the contrary, that the frequency of roentgenologically observed progression was not greater during the next 2 months after bronchoscopy than it was in the previous 2 months.

Kernan has described a case ending in a fatal haemorrhage after an endobronchial coagulation.

My own investigations.

In our material, it has not been possible to make a distinction with any certainty between cases of initial and cases of secondary rise in temperature. The lingering rise in temperature has, in the few cases where it has occurred, begun immediately after the bronchoscopic examination, and there has been no fever-free interval. Nor has it been able to be shown that the early rise in temperature was caused by the state of trauma induced by the operation itself, nor that the other rise in temperature was caused by the progression of the lung process itself. The rise in temperature has occurred on any day after the operation. As having some connection with the operation, every rise in temperature up to three weeks after the operation has been recorded in order to arrive at, if possible, the so-called secondary rise in temperature which should depend on a progression of the lung disease. The cause of the rise in temperature is certainly in many cases a banal infection, a so-called bronchitis, with more or less bronchial pneumonia depending on aspiration. It has only been possible to suspect this, because at the first rise in temperature a sulphadiazine or penicillin has been given. In most of the cases an immediate drop in temperature has been obtained, without there being any proof as to what was the cause of the same. In every case these have shown no signs of a spread of the tuberculous process. In 3 cases, however, there was an extension of the tuberculous process in connection with the bronchoscopic examination, but in all the cases a test excision was made at the same time, so it is impossible to deny a certain importance to the operation for the extension.

In our material, fever complications have occurred in 10 % of the bronchoscopic examinations (101 cases in 1001 examinations).

In bronchoscopic examination of those patients with fever developments after bronchoscopy, the following has been found:

Tuberculosis of the bronchial mucous membrane with stenosis	11
Tbc of the bronchial muc. mem. treated with silver nitrate	15*
Tbc of the bronchial muc. mem. treated with cautery	13
Bronchostenosis treated with silver nitrate	7
Adenitis fistula treated with silver nitrate and cautery	5
Non-specific bronchostenosis	1
Aspiration of pressure cavity	2
Susp. tbc of the bronchial mucous membrane	2
Desolate pulmonary tuberculosis with large cavity	6
Susp. tbc of the bronchial muc. mem. with lingering fever	1**
Secretion stagnation	1
Highly feverish with secretion stagnation, both before and after bronchoscopy	3
Narcosis bronchoscopy	1
Ditto, with silver nitrate occlusion treatment	1
Cautery occlusion treatment	3
Test excision for susp. tbc of bronchial muc. mem.	1
Non-specific bronchitis picture	8
Neg. bronchoscopic finding in clinically susp. tbc of the bronchial mucous membrane	13
Ditto in patients with plasty operations	1
Ditto and simultaneous obstruction of the phrenicus	1
Lymphadenitis	1
Control bronchoscopy	3
Test excision for bronchial cancer	1
Total	101

Besides the cases marked * and **, deterioration took place in connection with bronchoscopy in the afore-mentioned cases after test excision (3 cases). The other fever cases improved little by little or after a short time.

On examining the table, it may be seen that stenosis cases, taken together with cases of tuberculosis of the bronchial mucous membrane make up over half of the fever cases. These cases as a

* 1 death 4 months after bronchoscopy.

** much worse after bronchoscopy, and death 1 year after same.

rule have difficulty in getting rid of the secretion, those with stenosis because of obstructed voiding, and the others because the ciliary action is reduced in the centres affected. It is possible that these cases get aspiration more easily. Usually it is not possible to choose the time of the bronchoscopic examination so that it can be made at a time when the secretion is reduced and the danger of aspiration less. A striking number of negative bronchoscopic findings have, however, had rises of temperature.

Of the other complications arising in connection with the operation, there stands out especially irritation of the bronchial mucous membrane with increased secretion. Such complications were observed after 50 examinations. In a number of cases the excretion of aqueous secretion was so abundant that it was suspected that it might be a question of an allergic reaction. The complications have never been of a serious kind and have regressed of themselves or with the use of common expectorants.

In one case total atelectasis of one lung was produced in direct connection with bronchoscopy. When the bronchial tree is numbed, a certain numbing is also produced in the ciliary movements of the respiratory epithelium, and thereby the voiding of secretion in the bronchial tree is made more difficult. It is therefore surprising that an atelectasis does not arise as a consequence of the operation in a greater number of cases. A part of the secretion must obstruct the bronchi and in any case must be aspirated. The short duration of the numbing may perhaps be the reason why this complication is so rare. In this case of total atelectasis the bronchoscopic findings were negative.

In one case (no. 10), a minor hemophysis occurred after the 5th cautery in cautery treatment for occlusion. There was no after-haemorrhage in any of the cases treated with silver nitrate.

One case of diabetes which was examined bronchoscopically had a diabetic coma as a complication two hours after the operation.

Discussion: Post-bronchoscopic fever complications have kept round about 10 % which broadly agrees with the statistics drawn from several sources. We have not been able to distinguish between an early and a late fever complication as a number of other authors have. The rises in temperature have come on so irregularly after the different examinations that it has not been

possible to trace any regularity in them. All cases which had fever complications of longer duration underwent a control roentgenological examination. As a direct consequence of the operation, extension has not been observed in more than 3 cases, all 3 with test excisions also.

Of the cases with fever complications, more than half had bronchostenosis or tuberculosis of the bronchial mucous membrane, so that it seems credible that a certain difficulty in bringing up the secretion should be the cause of the fever complications. It is possible that aspiration of the secretion with consequent bronchitic irritation and eventually lesser bronchial pneumonias may be the cause of the fever. No certainty as to this could be gained since these patients received sulpha or penicillin treatment as soon as the temperature began to rise.

Of other complications, only a catharral irritation of the bronchial mucous membrane with abundant expectoration has occurred. These cases have never been of a serious kind.

One case of total atelectasis of one lung also occurred in a patient for whom the bronchoscopic findings were negative.

SUMMARY

The investigation comprises 1,001 bronchoscopic examinations on 420 patients received at a special hospital for pulmonary tuberculosis. In isolated cases it has been a question of patients who were received for observation on account of suspected pulmonary tuberculosis, but who showed themselves to be suffering from other diseases of the lung. The percentage division between men and women with regard to the patients examined was 47 % men and 53 % women, which makes up practically the same division as that of the patients received at the hospital.

The indications for bronchoscopy in pulmonary tuberculosis are fixed by the lung specialist, and as a rule as a question to which he requires a positive or a negative answer. The contraindications should be fixed by the bronchoscopist. Our contraindications have been: 1. Heavily impressed patient and 2. Extensive laryngeal tuberculosis.

For examination on account of *bronchial changes in lymphadenitis*, 21 patients were sent up, which constitutes a bare 5 % of all the patients under treatment in the hospital for lymphadenitis during the time covered by the investigation. The positive findings were 3 cases with bronchial constriction on account of swelling of the mucous membrane (adenitis pressure?). In 5 cases perforation of a lymphadenitis could be noted, and in 3 cases tuberculosis of the bronchial mucous membrane. In the latter 3 cases it could not be decided whether an adenitis perforation had existed at the beginning. In 10 cases the findings were entirely negative. The division by ages as far as the examined cases of lymphadenitis were concerned was: under 15 years 2, 15—25 years 11, 26—35 years 5, and over 35 years 3. Perforations are as a rule easy to recognize when they are examined at an early stage. Later, ulcerations develop which may be indistinguishable from tuberculosis of the bronchial mucous membrane from other causes. If the change lies in a position which is not near the opening of a bronchus, there is always the possibility of its being a question of lymph perforation in spite of the fact that its appearance is not typical.

On the whole material of 420 patients, *tuberculosis of the*

bronchial mucous membrane was observed in 71 cases (17 %), and in a further 62 cases (15 %), the findings gave rise to suspicions of tuberculosis of the bronchial mucous membrane. The division of tuberculosis of the bronchial mucous membrane has been 41 on the right side and 32 on the left side (2 cases had bilateral localisation). The suspected cases were localised on the right side in 30 cases and on the left side in 32 cases. In 4 cases an irritation free stenosis was observed which could have arisen through healed tuberculosis of the bronchial mucous membrane. In 88 cases the bronchoscopic findings were quite negative. In 52 cases, bronchial changes of a non-specific kind were observed. These non-specific changes were partly diffused, and partly localised in a small region. These latter had also produced broncho-stenosis in a number of cases.

The local treatment of tuberculosis of the bronchial mucous membrane has lost a great deal of its importance since streptomycin and PAS have begun to be used in these cases. Our treatment has consisted in cautery by means of silver nitrate solution of varying concentrations, from 10—50 %. Other cases have been treated by galvano-cautery. It appeared that the cases treated with galvanocautery led to bronchostenosis in greater numbers than the others. Of all the cases handled with local treatment, the tuberculosis of the bronchial mucous membrane healed in 16 cases without, and in 30 cases with bronchostenosis. 25 cases did not heal.

For suspicions of *bronchostenosis*, 147 cases were sent up, comprising 33 % of all the patients examined. Bronchostenosis could be shown bronchoscopically in 79 cases. The great number of negative findings with stenosis symptoms shows that the clinical symptoms are to a certain degree unreliable, or also that a stenosis may lie outside the range of the bronchoscope. In this investigation, however, a number of cases were sent up with very vague symptoms of bronchostenosis, but on which it was desired to carry out pneumothorax. Treatment by dilation gave no lasting results, in one case the general condition of the patient even deteriorated through fever periods of long duration and much lowered forces. However, it has sometimes been necessary to dilate a stenosis somewhat in order to carry out aspiration of stagnant secretion.

In a certain number of cases of clinically suspected *valve mechanism* in a bronchus, stenoses have been shown which give rise to suspicions that a valve mechanism exists. On account of suspected valve mechanism, 15 cases were sent up, 7 of them also with a direct enquiry as to whether bronchostenosis was present. In 6 of the cases a stenosis could be shown which probably caused a valve mechanism. The valve mechanism may, however, lie peripheral to the range of the bronchoscope, which probably explains why so many of these cases showed no signs of the suspected valve mechanism on bronchoscopic examination. The only form of bronchoscopic treatment which can be offered to these cases is the removal of the granulations which cause the valve. No case suitable for such treatment, however, came into our hands. Dilation was attempted, but gave no lasting results. Nor were the results obtained from aspiration treatment encouraging.

Bronchoscopy has in many cases been performed as a routine examination in cases of *atelectasis* which showed a tendency to persist. On account of atelectasis in the lung, 102 patients were sent up for examination. The question has usually been as to whether any cause for the atelectasis could be shown bronchoscopically. In 46 cases the cause of the atelectasis could be shown. Of these 46 cases, 27 had tuberculosis of the bronchial mucous membrane with or without bronchostenosis. Acute atelectasis had also arisen in a number of cases in connection with the carrying out of pneumothorax. The atelectasis cases were treated partly with silver nitrate cautery of the existing bronchial affection in the cavernous bronchus, and partly by aspiration of the part affected by atelectasis. After the former treatment, the atelectasis disappeared in 4 cases out of 23 treated. After aspiration, the atelectasis disappeared temporarily after a number of treatments, but gradually returned. No case of final healing resulted from aspiration treatment.

In many cases, warning has been given against bronchoscopy during a haemorrhage. Jackson, however, encourages activity in these cases if the reason for the haemorrhage is to be found. He considers that a major haemorrhage is to a certain extent an indication for bronchoscopy in order to prevent an atelectasis from arising. For examination on account of *haemorrhage for unknown cause*, 18 cases were sent up. The examination was carried out

from 10 days to 4 months after the cessation of the haemorrhage. In none of the cases could the bronchoscopic examination give the cause of the haemorrhage. Bronchoscopy must be carried out during the haemorrhage or immediately it has ceased in order for there to be some chance of deciding its origin. As regards tumours which bleed, the conditions are different. But even in these cases it is urgent to use the bronchoscope early.

Occlusion treatment for obtaining collapse and healing of the cavities is at a more experimental stage. Occlusion treatment was attempted in 27 cases out of 34 proposed. In 26 cases the treatment was carried out by galvano-cautery, and in one case with a 50 % solution of silver nitrate. In 7 of the cases treated by galvanocautery, the cavity collapsed and freedom from bacilli was obtained. The other cases were unimproved, or the treatment was broken off. The greatest success in occlusion treatment was obtained with those cases which showed a tuberculous bronchial change in the cavernous bronchus (5 cases). In 6 cases, it was considered that occlusion treatment should not be undertaken, in 2 of them because it was not possible to localise the cavernous bronchus, and in one case because the cavernous bronchus was much too wide. In 3 cases tuberculosis of the bronchial mucous membrane in the cavernous bronchus was treated with silver nitrate; all three became free from bacilli and the cavities collapsed, but in one case a relapse set in rather quickly. Because of deteriorated general condition, the treatment was not continued.

Aspiration treatment via the bronchoscope has been attempted partly in cases with pressure cavities, and partly in cases with larger cavities not of the pressure type which resisted the usual treatments. In addition, cases of stagnant secretion behind bronchostenoses or other forms of difficult voiding of secretion have been treated. 6 cases of pressure cavities were treated, and in no case did the cavity collapse. Results were also bad in cases with cavities of larger size, not of the pressure type. Of the cases treated (7), in 2 the cavities diminished, and in a further 2 the cavities collapsed after aspiration combined with another treatment (1 in connection with commenced occlusion treatment, and 1 after obstruction of the phrenicus).

The *extraction of secretion* shows that bronchoscopy can be of the greatest importance in deciding which side is producing the

bacilli. It is also of great importance when it is desired to obtain concentrated secretion for examination. The examination was carried out in 101 cases. Certain sources of error arise in these tests, and the clinician must be acquainted with these. It may happen that secretion runs over from the diseased side to the suspected healthy side, and this should be known to all. It has, however, been shown that patients who are positive for bacilli, have shown themselves to be negative for tuberculosis on examination of secretion taken up via the bronchoscope. As an explanation of this, it has been suggested that there is a possibility that the bacilli are not excreted continuously from the cavity.

Other examinations in cases of pulmonary tuberculosis have been carried out with reference to bronchial fistulas, and also for purposes of control. Of the former, 4 examinations were carried out without positive bronchoscopic findings. Control bronchoscopy was carried out in 100 cases. These were to a large extent cases treated with PAS and streptomycin.

Differential diagnosis questions often come up in connection with patients sent up for the elucidation of suspected tuberculosis. By means of bronchoscopic examination of this material from a tuberculosis hospital, 6 cases of bronchial cancer were revealed. 4 cases of Schaumann's lymphogranuloma benignum were found among the cases bronchoscopically examined for differential diagnosis purposes. In one case changes in the larynx were found, but in the others the bronchoscopic examination was negative. The diagnosis was fixed after the extirpation of a tonsil. Asthmatic symptoms are rather common in pulmonary tuberculosis. 11 such patients were examined. In 4 cases the result of the examination was negative. In 2 cases a bronchostenosis was present with existing tuberculosis of the bronchial mucous membrane, and in 3 cases there was a bronchostenosis without any existing affection of the mucous membrane, while in the 2 remaining cases there was a diffuse bronchial irritation without specific signs or stenosis.

An important group of bronchoscopic examinations has been *routine bronchoscopy* before carrying out a pneumothorax, before a thoracoplasty operation and before lobectomy or pulmectomy. In 24 cases bronchoscopy had been performed before a pneumothorax purely as a matter of routine, or there existed a certain clinical suspicion of bronchostenosis, or it was desired to be sure that

stenosis was not present. In 3 cases pneumothorax was not carried out on account of bronchostenosis, but in 1 case of relative stenosis, pneumothorax was carried out without complications. In 21 cases pneumothorax was carried out without previous bronchoscopic examination and atelectasis resulted. 6 of these atelectases had arisen in immediate connection with the operation. In 3 of these cases, bronchoscopy showed bronchostenosis. In one case of simultaneous pneumothorax and obstruction of the phrenicus, there was acute onset of atelectasis, and in this case the bronchoscopic findings were negative. Atelectases running a chronic course in connection with pneumothorax had a smaller number of bronchoscopically demonstrable stenoses. It would be of great benefit if, by bronchoscopic examination, it was possible to distinguish those cases which are not suitable for pneumothorax. Further experience will possibly enable these cases to be distinguished with greater certainty than at present. From different sources the importance of bronchoscopic examination has been pointed out before every surgical operation on the lungs, and this is naturally especially true of pulmectomy or lobectomy, in which it must be decided if there is a healthy bronchial stump before the operation is undertaken.

A special investigation has been carried out in order to find out whether *test excisions* in tuberculosis of the bronchial mucous membrane, or suspected such, entail any inconveniences. Of 8 cases with positive tuberculous findings, 2 showed progression after test excisions. In one case with a negative test excision, a bronchogenous extension of the tuberculosis arose after the test excision. Even if these three cases do not constitute a proof that there is any direct danger in making a test excision, they nevertheless give a certain warning.

Complications were: 4 cases heavily impressed by the anaesthesia of which one died. During the operation itself the complications consisted of damage to teeth in two cases, and some cases of unimportant haemorrhage. Fever complications arose in 10 % of the bronchoscopic examinations and mainly in cases of tuberculosis of the bronchial mucous membrane and bronchostenoses. In 50 cases there was bronchial irritation with increased secretion. In one case of galvano-cautery there was a haemorrhage in the after course of the treatment.

The investigation shows that bronchoscopy gives the clinician much precious information from a diagnostic and therapeutic point of view, and that it is to a less extensive degree an independent auxiliary therapeutic means. As far as complications are concerned, anaesthesia constitutes the greatest danger, but, by knowledge of the right methods of treatment, such fatalities should to a great extent be overcome.

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